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AVIATION

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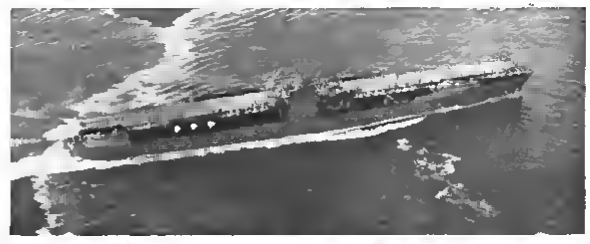
Briefing for June



Carrier based aviation, once loudly berated by self-styled "experts," has emerged as a new weapon, one which has changed both strategic and tactical concepts of warfare. How this new typically American weapon evolved and how it is being used is told dramatically by Rear Adm. DeWitt C. Ramsey, Chief of the Navy's Bureau of Aeronautics, in "America's Prime Weapon," beginning on page 110. (Official U. S. Navy photo.)

When the aircraft manufacturing industry—long famed for its internecine warfare—really got down to unparalleled cooperation in war production, many old timers thought they had seen a miracle. Now, however, they can truthfully say they've seen everything—for today the industry is working to continue that cooperation into the peace. Through the revitalized Aero Chamber of Commerce, the industry has written a recommendation for an American Air Power Policy, a truly important document. For "the record," we present it in its entirety (page 108).

Many and varied have been the predictions on the airplane's place in the coming peacetime economy. Few, however, have been presented by aeronautical engineers who know whereof they speak. Beginning on page 120, we inaugurate a thorough-going series by Frederic Flader, offering for the first time an "economy yardstick" applicable not only to currently used conventional engine-propeller units but also to jet-propelled and propeller-jet combinations.

One of the best word pictures we've seen of the inside of a blind-flying pilot's head starts the article by Jean Hamelet, Convair flight captain. But, fortunately, he doesn't stop there, he comes up with a good flying man's plea not only for rearrangement of blind flying instruments but also re-design. This intriguing story begins on page 138.

So you'd like to open a fly-yourself service? Well, it'll "cost more than a quarter and take a lot of faith" says Howard Ailor. And he ought to know, for he operated the nation's biggest such service before the war. You'll find the cold facts, written from his own experience, in "Fly Yourself is Big Business" (page 185).

Coastedly increasing sizes of aircraft make the automatic pilot more and more important, both to the designer and the maintenance man. On page 140, Dr. Stephen J. Zand, director of Sperry's Vose Memorial Laboratory, gives a timely description of automatic flight principles which will fill a much-felt need for technical reference work in this ever more-important field.

As aircraft uses of cellulose acetate plastics broaden, designers and engineers find themselves in greater need for facts and figures on the load resisting qualities of these materials. To answer that need we start this month (on page 146) an exhaustive analysis by William T. Findley, asst. prof. of Theoretical and Applied Mechanics at the University of Illinois College of Engineering.

Agile thinks plenty of material for the maintenance man. First (on page 161) T. J. Kearney, technical assistant to the vice president, Dextrex Corp., details a new and efficient system for getting aircraft parts cleaned up preparatory to overhaul. . . Then, in "Zero-Lash" (page 165) will be found clear, concise procedures for adjusting push rods on the widely used Franklin Aircooled engine. . . On page 167 begins a profusely illustrated step-by-step account of recommended methods for inspecting, cleaning, and adjusting shielded sparkplugs. . . For those operators who want to cut engine overhaul time—and who doesn't?—J. R. Horton, vice president of Embry-Riddle Co., describes time-savers which have increased capacity of the overhaul shop. . . and in addition, there's a complete description of the parts—and their functions—in the MA-3A Marvel-Schebler carburetor, plus procedures for both hot and cold starting. And, with apologies to the movies, all this and the Maintenance Notebook, too.

Aed—continued from last month. Second and concluding installment of Detroit Editor Chester S. Ricker's superb "Design Analysis of the deHavilland "Mosquito", beginning on page 123. . . Associate Editor John Foster's outstanding manufacturer-distributor market analysis (page 114), which in this installment covers the middle of the country, giving data on the East and North Central and East and West South Central Regions. . . Also Part II of "Methods for Forming Sheet Aluminum" where the reader will find a graphic description of standardized shop procedure followed in the spinning branch of the industry.

Down the Years in AVIATION'S Log

25 Yrs. Ago (1919)—Naval airship C-5 cruises 1,100 mi. nonstop under adverse weather conditions but is wrecked at moorings. . . N. Y.-Washington airmail shows $19,000 profit for year. . . Assistant Sec'y of War Benedict Crowell sails for Europe with Air Commission to study civil aviation. . . Unlicensed aviator pilots flying boat over heads of crowd at Fifth Avenue military parade. . .

15 Yrs. Ago (1929)—Rohbins and Kelly establish refueling endurance flight record of 172 hr. 32 min. at Ft. Worth. . . Lt. W. C. Tomlinson wins Curtiss Marine Trophy race flying *Hawk* 100 mi. at 173 mph. . . D. of C. Aeronautics Branch appoints flying school inspectors. . . Pitcairn-Cierva builds $100,000 autogiro factory. . . Indianapolis "flying cop" forces down and arrests pilot whose plane endangered balloon. . . Junkers *Bremen* presented to New York City and exhibited in Grand Central Station. . . Aerial mapping firm organized in Portland, Ore. . . American Glider Assn. organized in Los Angeles. . . Fairchild says employees have risen from 9 to 800 in three years. . . Florida has 20 airports in operation. . . Goodyear-Zeppelin announces training course for pilots for projected trans-Pacific air route. . . Night airmail started between Pittsburgh and Cleveland. . . Bolivia Gold Exploration Co. swaps gold ingots for Travel Air planes.

10 Yrs. Ago (1934)—Pan American opens International Air Terminal at Dinner Key, Fla. . . . Chinese build world's first floating hangar. . . Air Corps announces exhaust-turbine-supercharged Curtiss P-30.

THE KOLLSMAN VERTICAL SPEED INDICATOR is so sensitive that a pressure differential of but one millimeter of water causes the instrument to register 100 feet on the dial. This is comparable to the difference in pressure between the inside and outside of a soap bubble. Friction is reduced almost to the vanishing point by ingenuity of design and precision manufacture. But despite its delicacy, the instrument is compact, light in weight, rugged, dependable . . . characteristic of all Kollsman aircraft instruments.

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK — GLENDALE, CALIFORNIA

After Victory you can land your Piper Cub at Fairville and countless other towns which are building landing facilities today. These communities are looking ahead to the coming air age—providing flying facilities for their sons and daughters upon their return from the Service.

Fairville's landing area is modest—just a simple, straight sod strip. But there's ample room for expansion as traffic warrants.

Is your town ready to fly? For its citizens' convenience, increased business and many other benefits, your town should plan landing facilities now! A new booklet, "What Your Town Needs for the Coming Air Age", gives the why, where and how of building landing facilities. For your free copy, write Piper Aircraft Corporation, Department A64W, Lock Haven, Pennsylvania.

GET YOUR AVIATION BOOKLET— Piper Cub in War and in Peace. Full color 32 pages. Covers history of light plane, Piper Cub planes, coming air age, how to fly. Enclose 10c in stamps or coin for postage handling. Write Piper Aircraft Corporation, Department A64, Lock Haven, Pennsylvania.

16mm. SOUND FILM— "The Construction of a Light Airplane." For distribution points write Supervisor, Audio Visual Aids Extension Service, Pennsylvania State College, State College, Pennsylvania.

PIPER Cub

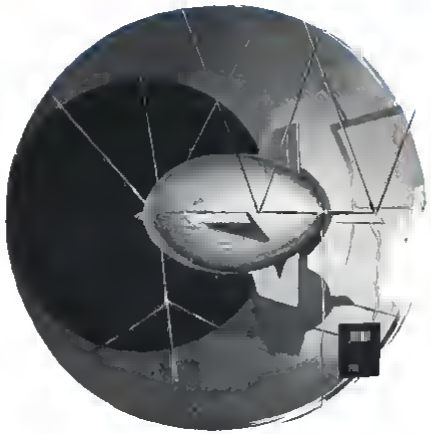
Points the Way to Wings for All Americans

Trail Blazing in the Skies

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

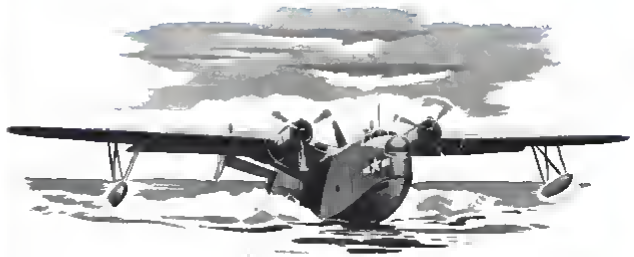
1. *By constructing subassemblies to manufacturers' specifications*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for quantity production*
4. *By building complete airplanes and airships.*
5. *By extending Goodyear Research facilities to aid the solution of any design or engineering problem.*

PIONEERING NEW METHODS



GUST EFFECTS ON AIRSHIPS were extensively studied and tested by Goodyear and the Navy long before their importance in building heavier-than-air craft became evident. Special wind tunnel equipment was initiated to simulate, upon scale-model airships, the aerodynamic forces created by gusts of varying intensity. These tests provided the basis for computing stresses resulting from gust disturbances on ships in flight This long and tedious research contributed importantly to present-day knowledge of the effects of atmospheric disturbances on aircraft — increasingly important today as larger airplanes are being built This is another example of the breadth of Goodyear's background in aircraft development

BUILDING PROVEN AIRCRAFT PARTS



THE FAR-RANGING MARTIN PBM-3 is another of America's dependable planes built in part by Goodyear Aircraft. Large numbers of these long-distance patrol bombers now in service are equipped with ailerons, flaps and empennages fabricated by Goodyear. In building components for the PBM-3 and other famous aircraft Goodyear has the advantage of its long experience and extensive research in all branches of aeronautics — a background that goes back to the very early days of aeronautics. This time-proved skill is further attested by Goodyear's standout record in building complete aircraft, including both the superb Corsair fighter and naval patrol airships

BUY WAR BONDS BUY FOR KEEPS

GOODYEAR AIRCRAFT

On the Record—
THE BEST WHEELS TO SPECIFY!

There are good and substantial reasons why Goodyear magnesium-alloy airplane wheels are first choice of America's leading aircraft engineers:

The magnesium-alloy airplane wheel was first pioneered by Goodyear more than ten years ago, hence Goodyear has the most experience in its design and construction.

The alloy castings used in Goodyear wheels are tested by X-ray, the analytical spectograph and other ultra modern scientific instruments to check purity of composition and freedom from hidden faults, insuring wheels of uniform strength and quality.

Goodyear today is using more magnesium in wheel manufacture alone than the entire magnesium foundry capacity of the United States before the war.

Goodyear wheels in combination with either the Goodyear Multiple Disc Brake or Single Disc Brake affords the lightest, sturdiest, trimmest, most perfectly balanced and most efficient wheel-brake assembly available.

These time-proved wheels and brakes are made in a complete range of sizes for every type of aircraft from light trainers to the largest super-bombers and transports now in use, or in prospect. Our engineers will be glad to consult with you on any problem.

WHAT'S NEW IN RUBBER FOR AMERICAN AIRCRAFT

A DE-ICER FOR PROPELLERS

The hazard of ice forming on propellers — with the attendant dangers of lessened air bite," heavy strain on engines and damage to wings or fuselage from thrown pieces — is eliminated by the new Goodyear Anti-Ice Propeller Boot. Built of synthetic rubber specially compounded to conduct electricity, the boot is heated by a small generator mounted in the propeller hub, and adds only a pound in weight to each blade.

SEA-GOING TIRES

For use on carrier-based Navy aircraft Goodyear builds a sturdy high pressure airplane tire that meets the rugged demands of this severe service. A product of Goodyear's 35 years' experience in building pneumatic airplane tires, the high pressure has made an exceptional record in ship-borne duty.

HOW CAN RUBBER HEADQUARTERS SERVE YOU?

Since 1909 Goodyear research engineers have been engaged in improving airplane tires, tubes, wheels, brake and other aircraft accessories. Today the facilities of the great Goodyear Research Laboratory are at your service in working out any problem involving such products, especially those made of rubber — either natural or synthetic. Write Goodyear, Aeronautics Dept., Akron 16, Ohio, or Los Angeles 54, California.

BUY WAR BONDS—
BUY FOR KEEPS!

GOODYEAR
THE GREATEST NAME IN RUBBER

AERONAUTICAL RUBBER GOODS — TIRES • TUBES • WHEELS • BRAKES

Electric Actuators

Provide Torque for Retraction of Landing Gear ... Bomb Bay Doors, Flaps, and other functions

Design Check Chart for Eclipse Electric Actuators

APPLICATION

✔ Eclipse Electric Actuators, available in various capacities, provide the mechanical muscle, known as torque, for retraction of aircraft landing gear, operation of bomb bay doors, wing flaps, and similar applications.

✔ An electric actuator installation comprises a reversible motor unit, specially designed for the particular operation to be performed, plus a suitable solenoid switch for each direction of motor rotation, a selector switch on the control panel, and suitable limit switches.

PERFORMANCE

✔ Motors are designed for 24-volt DC operation.

✔ Performance characteristics vary with individual airplane designs. Inquiries are cordially invited concerning your actuator requirements.

DESIGN

✔ An automatic, compensating torque limiting device, in the form of a multiple disc clutch, protects reduction gearing and motor in event of undue loading.

✔ A special magnetic equalizing clutch prevents over-running and jamming. This feature also facilitates hand operation on models so equipped (see Specification Chart) by eliminating resistance of gear train and motor.

✔ Motors are available in both concentric and right-angle design to provide maximum compactness and clearance, depending on the characteristics of the installation under consideration.

✔ Explosion-proof motors, available in certain models (see Specification Chart), are completely enclosed against explosive vapors, as well as mud and dirt.

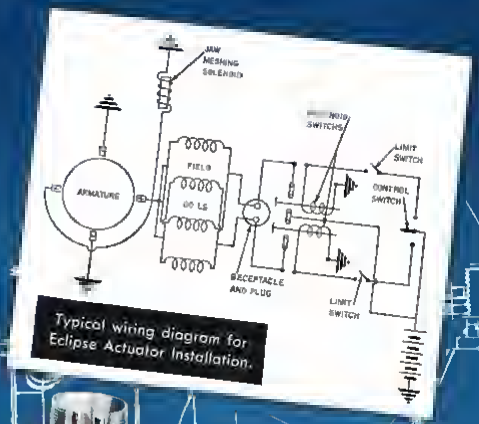
*Eclipse is a Trade Mark of Bendix Aviation Corporation

SPECIFICATION CHART ECLIPSE ELECTRIC ACTUATORS

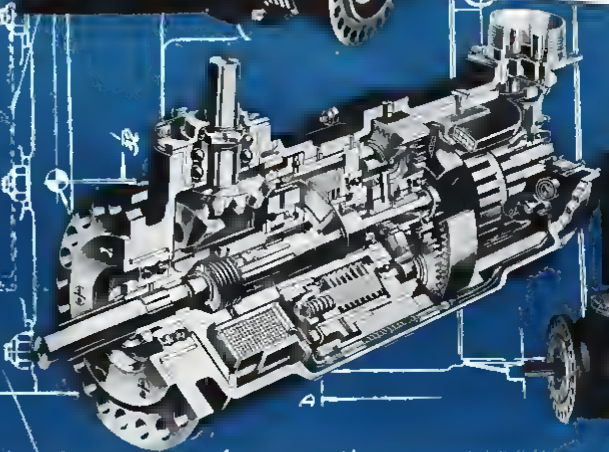
Eclipse Designation (Type)	Present Application	Wiring Connection	Clutch Setting Lb. Ft.	Design	Hand Crank	Explosion Proof	Weight Lbs.
1061-2	Landing Gear	Disconnect Plug	375	Concentric	No	Yes	35.0
1063-2	Wing Flap	Disconnect Plug	125	Concentric	Yes	Yes	30.75
1073-1	Bomb Door	Terminals	100	Right Angle	No	No	21.0
1073-2	Landing Gear	Terminals	100	Right Angle	Yes	No	22.75
1063-1	Nosewheel Door	Disconnect Plug	100	Concentric	No	Yes	28.5
1064-2	Bomb Door	Disconnect Plug	62.5	Concentric	No	Yes	18.5
784-1	Wing Flap	Terminals	50	Concentric	No	No	18.0
1227-1	Tail Wheel	Terminals	33	Right Angle	Yes	No	19.25

Mounting: All the units with the exception of Type 1061-2 have the following mounting characteristics: Flange Diameter 4 11/16" ; Pilot diameter 2.997" ; Number of holes, 24; Hole diameter 11/64" ; Bolt circle diameter 4". Type 1061-2 has 6" flange; Pilot diameter 3.997" ; 6 11/64" mounting holes and Bolt circle diameter 5 1/4".

Eclipse Type 1227-1 Right-Angle Electric Actuator, designed to operate tail wheels. Clutch set 33 lb. ft.



Typical wiring diagram for Eclipse Actuator Installation.



Eclipse Type 1063-2 Concentric Electric Actuator, designed to operate wing flaps. Clutch set 125 lb. ft.

RELUBRICATION CAUTION PLATE

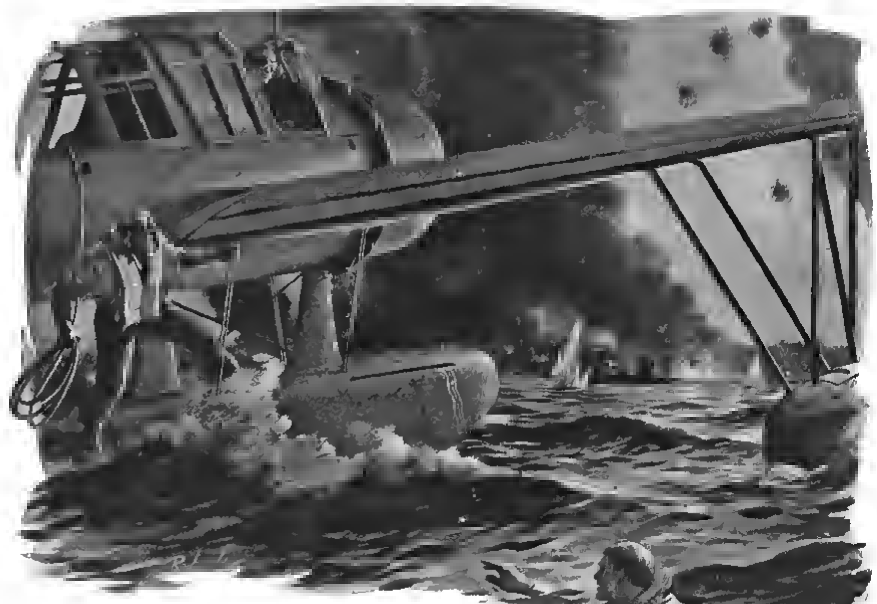
ONE MILLION HOURS CLOSER TO VICTORY!

Eclipse AVIATION ACCESSORIES

Eclipse-Pioneer Division

Teterboro, N. J.—Los Angeles 36, Cal.

THE INVISIBLE CREW Precision Equipment by Bendix Aviation Corporation



MIRACLE RESCUE

. . . a Story of Truk

Jap fliers had spotted our fleet far out at sea on that memorable mid-February afternoon Truk—chief stronghold of the Nips in the Carolines—was warned and ready But our Naval strategists had planned carefully for Victory Our task force closed in resolutely for the initial blow at the powerful Jap base [illegible] a smashing pre-dawn attack which was to put 23 enemy ships and 201 of his planes out of this war for good!

As our fighters and dive bombers swooped down into the murky haze of the Truk lagoon, they were met by deadly flak from rows of enemy ships and shore batteries The fighter plane flown by Lt (j g) George N Blair, USNR, daring 22-year-old pilot from Sewickley, Pa , was hit repeatedly At 300 feet, Blair felt his engine freeze, his propeller stop With cool American nerve, he negotiated his landing in the rough waters of the lagoon—the very heart of the Jap island-fortress!

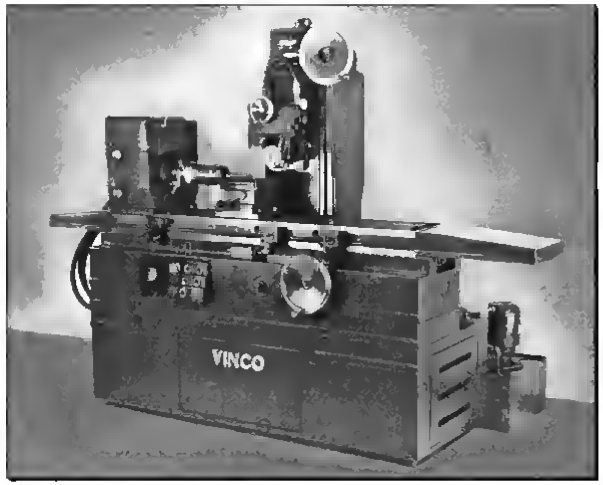
A Hellcat (on wheel gear) goes down fast at sea So fast, Blair could not retrieve his rubber boat Treading water with the help of his 'Mae West," Blair struggled free from his parachute harness and took stock of his plight Desperate? Well did Blair know! But his decision proved the mettle of our Navy pilots He would not swim toward hostile shores Instead, he would take the *one-in-a million chance* of a rescue in full view of watching slant-eyes

The Japs on a destroyer decided Blair was a sitting duck Twelve times they trained the fire of their 5 inch guns (!) on him before two of Blair's fighter pilot wingmates could dive their planes to strafe the destroyer But strafe it they did—set it afire, and turned it back! "It was mighty comforting," said Blair

For three long hours that seemed an eternity, his spirits rising and falling with each circling and passing plane, Blair drifted about waiting for help to come Then a Kingfisher whizzed by overhead! The seaplane pilot, at first, failed to spot Blair But Blair's fighter friends soon guided the Kingfisher to their buddy in the water

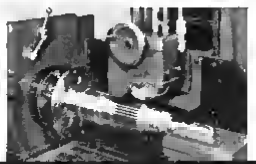
Every minute counted now The surface of the great lagoon was rough [illegible] dangerous for a landing But OS2U-3 pilots are skilled And Edo floats can "take it" Without hesitation, Kingfisher pilot Lt (j g) Denver F. Baxter, USNR of Summertown, Tenn , "bounced in" for a safe landing With the help of Radioman Reuben Hickman, Blair climbed aboard and crowded into the rear cockpit. The Kingfisher had been stripped of all extra gear—to assure quick take off with Blair's added weight Up rose the Kingfisher, now protected by circling fighters *One of the Navy's most daring rescues of sea was written into the history of the present war*

Lt Blair had seen Truk at close hand [illegible] too close for comfort But thanks to the resourcefulness of Navy pilots—and the seaworthiness of rugged Edo floats on our Navy planes—he was returned safely to duty His shipmates call him "the luckiest man in the Pacific



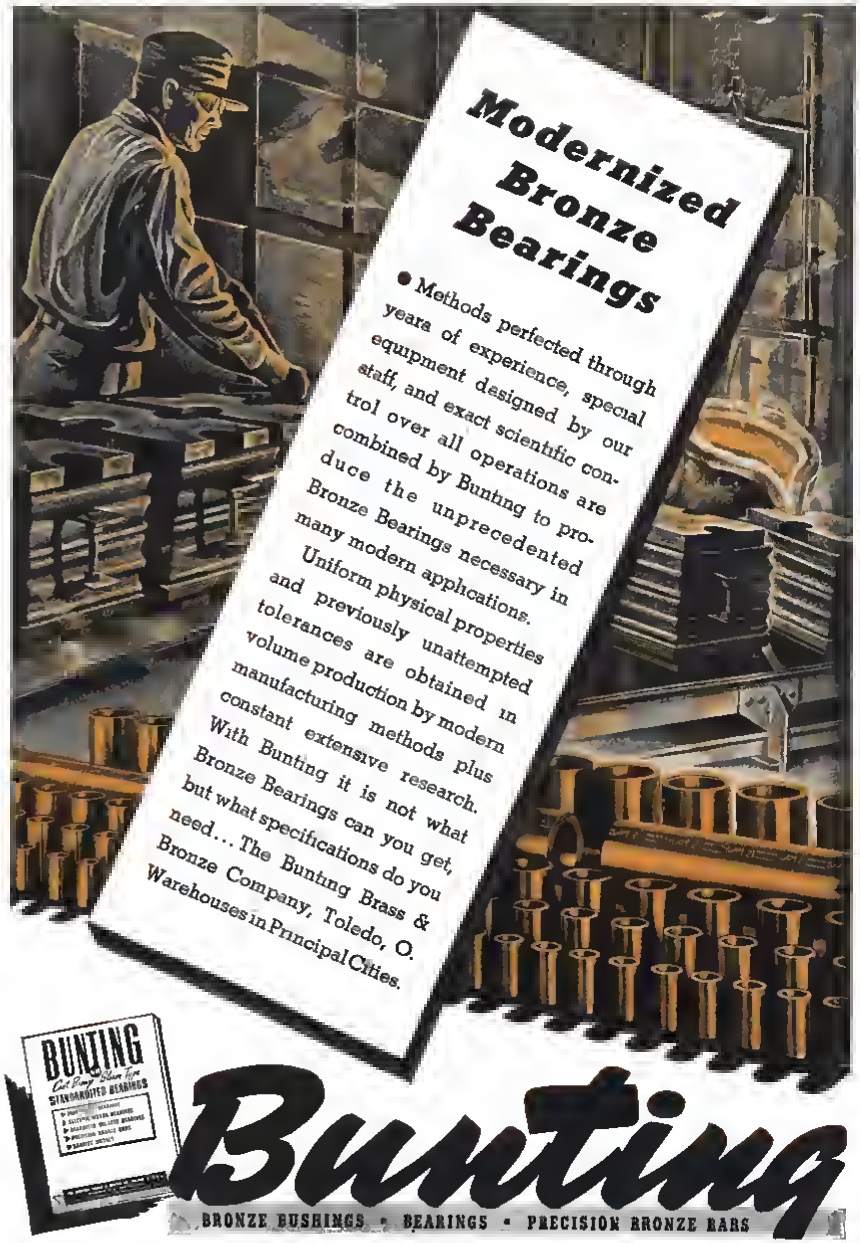
VINCO SPLINE & GEAR GRINDER

Here is a grinder that can safely be termed "super". Semi-automatic, hydraulically controlled, it does a fast, accurate job of grinding splines and gears in production. Wheel dressing and wheel feeding are the only non-automatic operations, and the only adjustment necessary is to compensate for wear of the dresser diamond. Its high degree of accuracy is due to a number of exclusive features—chief of which are the index head and plate, the index spindle, the wheel spindle and the Hydraulic Controls. The work, when indexed, instead of coming to an abrupt stop, is slowed by hydraulic action in the index head and the pawl drops gently into the slot of the master index plate. The plate is made with gage accuracy, being guaranteed accurate to within .0003" accumulated error. The index spindle is mounted in special ball bearings and so closely fitted that there is no radial play or end play. The wheel spindle is driven by belts from a motor mounted in the column. Hydraulic "Feed and Deceleration" valves control the table which is slowed to a stop at each end of the stroke, thus preventing any jar. Similarly, its return is gradually accelerated for the first 1½" of stroke. Through our pressure regulator, practically constant pressure is maintained and uniform rate of feed accomplished. Automatic timing and synchronization of all movements is a tribute to the engineering skill behind this exceptional machine tool. Write for specifications.



VINCO CORPORATION
8865 SCHAEFER HIGHWAY
DETROIT 27, MICHIGAN

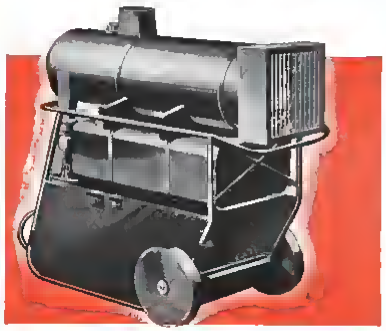
MILLIONTHS OF AN INCH FOR SALE BY VINCO



Backed by more than 30 years of combustion research

THE Janitrol Aircraft Heater and Portable Ground Heater are the latest in a long list of important heating advances, based on research and development work by Surface Combustion. Thousands of these heaters are now being used in United Nations' ships.

Surface Combustion is America's oldest and largest manufacturer of gas-fired industrial and domestic heating equipment and has pioneered in improving heating processes for many uses.



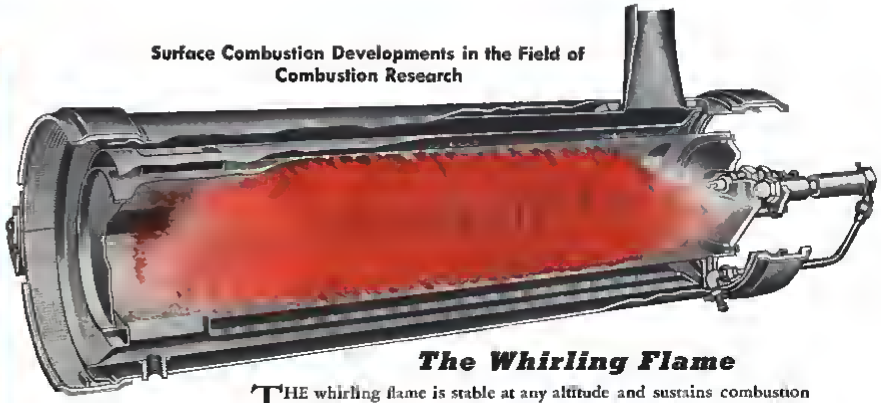
Janitrol Portable Ground Heater (Model No. PBS-250-44) equipped with gasoline engine or electric motor. Adjustable louvered outlet shown

Surface Combustion developments include One-Way-Fired Soaking Pits for steel mills, heating and heat-treating furnaces for a wide variety of industrial uses, special atmosphere generators, Kathabar systems for humidity control, the radiant tube heating element, the Conjecto Firing System and more than 50 types and 500 sizes of automatic proportioning burners.

The Janitrol Aircraft Heater, based on the Whirling Flame principle, was a logical addition to these other Surface Combustion heating developments. It was specifically designed to operate at all altitudes and to provide fast, positive lighting at temperatures down to 70 degrees below zero.

The unique facilities of this company, with more than 30 years' experience in successfully solving heating problems, are available to help you work out the heating systems of your new ships. Write to Surface Combustion, Aircraft Heater Division, Toledo 1, Ohio.

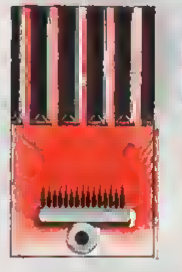
Surface Combustion Developments in the Field of Combustion Research

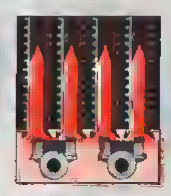


The Whirling Flame

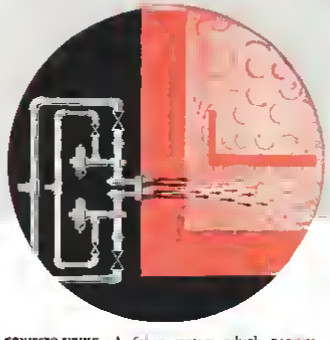
THE whirling flame is stable at any altitude and sustains combustion under the most adverse conditions because it is whirled around itself many times. Thus ignition is continuous and the combustion process is "self-piloting". The whirling is produced by introducing air into the cylindrical combustion tube tangentially to its inner surface. The liquid fuel enters the combustion tube through a vaporizer or spray nozzle ahead of the combustion air inlet.

THE RADIANT TUBE—An outstanding development in the field of heat treating, widely used in the aviation, automotive, steel, non ferrous and light metal industries.



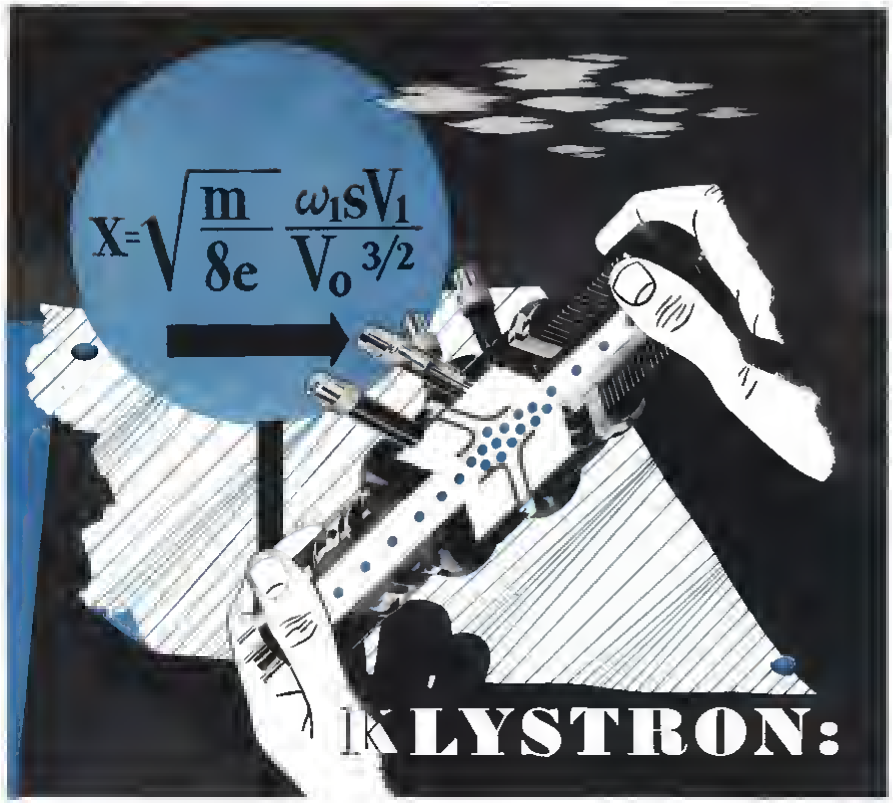


THE MULTI-THERMEX HEAT EXCHANGER—A compact, effective and long-lived development for domestic furnaces which eliminates the necessity for the conventional combustion chamber (left), permits the designing of much smaller more compact furnaces (above).



CONJECTO FIRING—A firing system which permits rapid heating and very accurate control of temperatures over a wide range, for such operations as drawing, annealing, hardening, normalizing and carburizing.

SURFACE COMBUSTION
Janitrol
AIRCRAFT HEATERS
with the whirling flame



Mathematically, here's the inside story

THE FORMULA in the picture above is an expression of *bunching* as it takes place in the Klystron tube

This Sperry tube converts DC energy into radio frequency energy by allowing an electron beam to become bunched or pulsating, between spaced grids

▶ The ultra-high-frequency micro-waves thus generated can be concentrated into a narrow beam and directed with great accuracy.

Various other forms of the Klystron have been developed by Sperry to aid in the amplification and reception of ultra-high-frequency waves Today they are vital parts of many a device used by our Armed Forces.

The name "KLYSTRON" is a registered trade-mark of the Sperry Gyroscope Company, Inc. Like other Sperry devices, Klystrons are also being made during the emergency by other companes.

▶ Klystrons are now being produced in quantities, and certain types are available. Write us for information.

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INC
GREAT NECK, N. Y. • DIVISION OF THE SPERRY CORPORATION

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"...A WORTHY *Contribution* TO PISTON RING LITERATURE..."

● This is the verdict of an executive of a large Aircraft Supply Distributor whose letter is only one among many enthusiastic commentaries about Muskegon's Aircraft Piston Ring Manual.

Full of only the best service and installation practices as recommended by engine builders, air-line service executives and civilian and military service personnel, the Manual is informative, interesting and amply illustrated. There are many helpful charts and tabulations.

Send for your free copy today if you are interested in aircraft maintenance. When writing please inform us of your position or the activity in which you are engaged.

MUSKEGON Piston Rings

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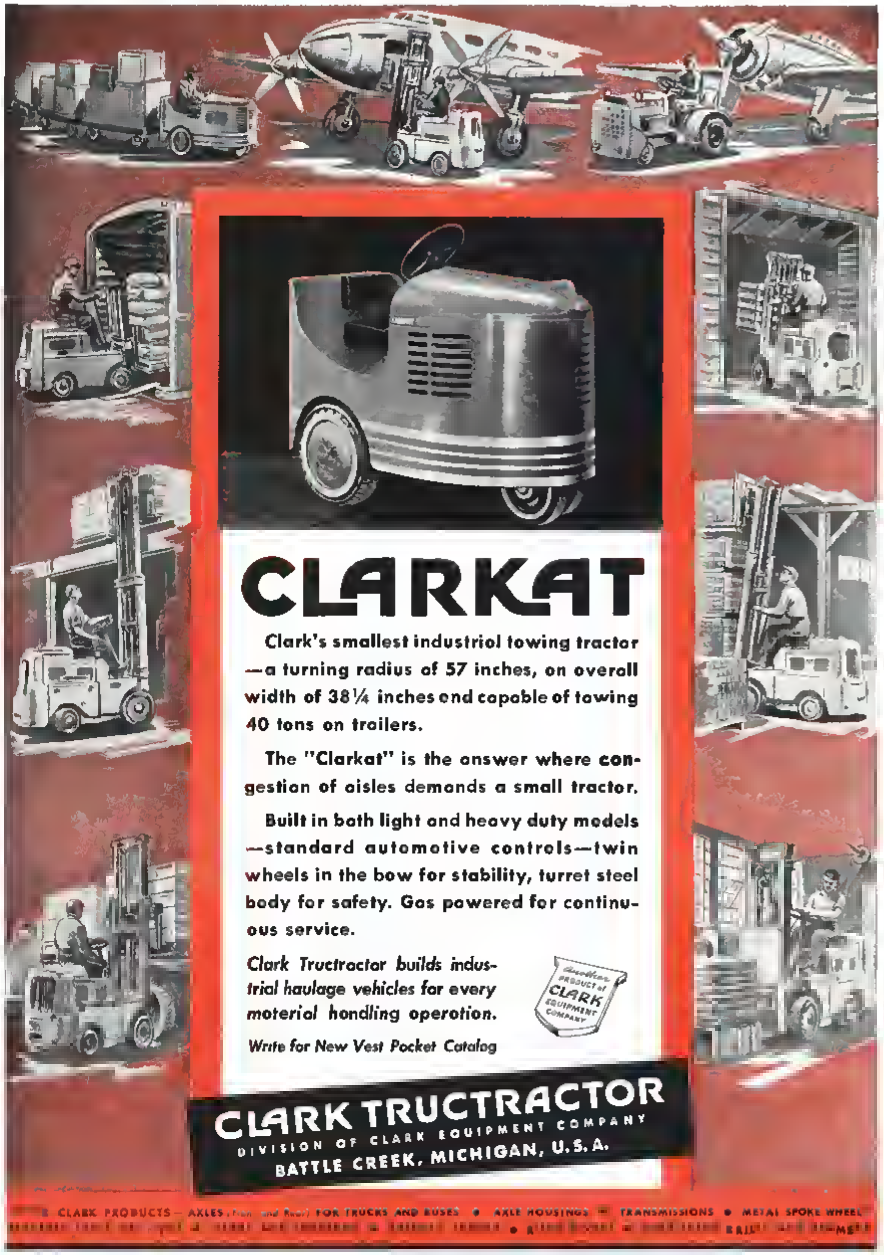
PLANTS AT MUSKEGON AND SPARTA



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Clark's smallest industriol towing tractor —a turning radius of 57 inches, on overall width of 38¼ inches end capable of towing 40 tons on trailers.

The "Clarkat" is the answer where congestion of aisles demands a small tractor.

Built in both light and heavy duty models —standard automotive controls—twin wheels in the bow for stability, turret steel body for safety. Gas powered for continuous service.

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BATTLE CREEK, MICHIGAN, U.S.A.

CLARK PRODUCTS — AXLES, Front and Rear FOR TRUCKS AND BUSES • AXLE HOUSINGS — TRANSMISSIONS • METAL SPOKE WHEELS

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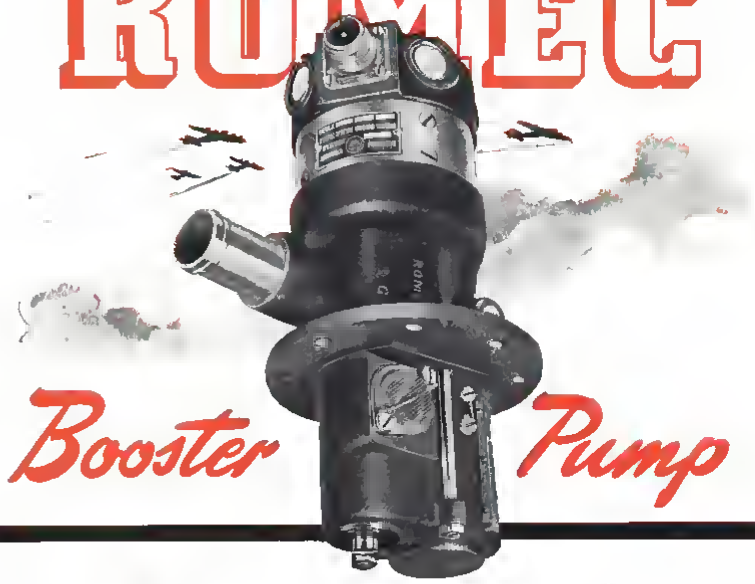

Booster Pump

8-10-A

FOR HIGH ALTITUDE PLANES

This is another new positive displacement Booster Fuel Pump built by ROMEC for increased efficiency for high-altitude planes. It assures better performance in vapor handling. With this new development, the tank can be pumped almost dry. Retains prime even in shallow tanks. Designed to mount on fuel tank with pump section submerged. Relief valve returns excess fuel above the inlet, within the tank, to prevent vapor from entering the pump in high altitude flying. Built with a 24 volt D.C. Motor. Can be used for starting and as an emergency pump. Capacity 400 g.p.h. at 15 p.s.i. gage pressure. Weight 6 lbs. 4 oz.

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In every processing and cleaning operation there is one specific chemical combination which precisely fills the requirements of a particular situation and will do the job best. The difference between this correct material and anything else—even the closest approximation—is extreme. Kelite sees it every day in reports from Service Engineers in the field. You can see it in the unequalled speed, certainty and economy which the correct material makes possible.

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This matter of the right material for the job is so important that Kelite has gone to great lengths to attain it. Formerly, standardized test tubes of correct solutions were made up in the laboratory and used as models on the job. All this work was worth while, but it was slow . . . until we learned how to make use of pH. Now it's simple!

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An operator does not have to be skilled to use Kelite pH Control. The pH values are lined up and compared in an easily-understandable form on the Kelite pH Chart. It's as easy to use as a yardstick! Your inquiry is invited.

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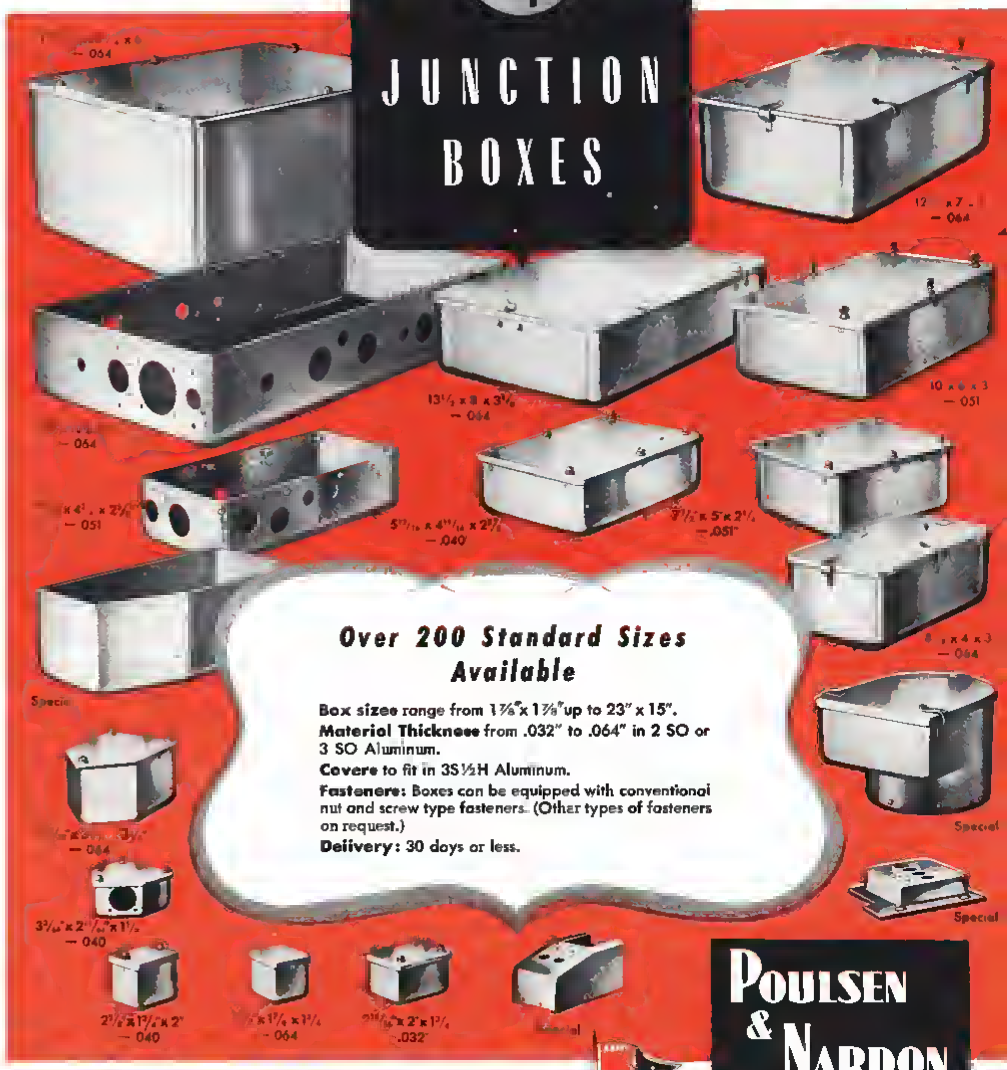

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EXIDES USED BY PAN-AMERICAN FLIERS

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EXIDES USED ON EVERY FLYING FRONT

There were many notable flights in the 1920's, among which the U. S. Army Pan-American Good Will Flight was very outstanding. Four Loening amphibians made the historic trip of more than 20,000 miles and in many ways it helped our "Good-Neighbor" Policy.

All of these planes were equipped with Exide Aircraft Batteries. This early flight, and many others, proved the dependability of Exide Batteries in the air, and laid the groundwork for research that made possible the modern Exide Aircraft Battery.

Today, our military planes depend on Exides on every fighting front. The success and efficiency of these modern Aircraft batteries is due, in part, to the early pioneers . . . to such men as the Pan-American Fliers.

Here's an interesting letter from a former Exide employee who has completed 7000 miles of flying in a B-17:

"I'm glad to say that the Air Corps depends on good old Exide. And I know the friends I have back there have not forgotten the work that goes into those Exides. You say 'When it's an Exide you start!' . . . I know, because it helped me many times in our overseas training."

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"ONE MILLION HOURS CLOSER TO VICTORY"

Preview of a new Bell Fighter*

* *Described by the Office of War Information as "A new Bell fighter, now in production, with a low drag wing and a two stage, supercharged Allison engine which will make it an efficient plane at any altitude up to 38,000 to 40,000 feet."*

When the Axis powers get their first view of this U. S. Army fighter, just beginning to come off the production lines in our Niagara Frontier plants, they'll see it as a slim, trim, single-engine plane. They'll learn next that it has blinding speed . . . that it can fight effectively high in the sky . . . or blast troops and tanks from tree-top level. Like the Airacobra, "Cannon on Wings," this plane has plenty of firepower. It throws a paralyzing barrage of machine gun bullets and cannon shells.

Manufacturing this new fighter is one part of Bell Aircraft's war job.

Now add four more chapters—(1) building flexible gun mounts for planes and surface ships, (2) designing and building America's first jet-propelled plane, (3) developing the new Bell Helicopter, (4) producing bombers in Georgia—and you have the complete story of Bell Aircraft's war effort.

Yes, Bell is concentrating to speed the day of peace. And the lessons we're learning today mean that you can aim *high* when you think about post-war aviation. © Bell Aircraft Corporation

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL—EAST COAST, INC.

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

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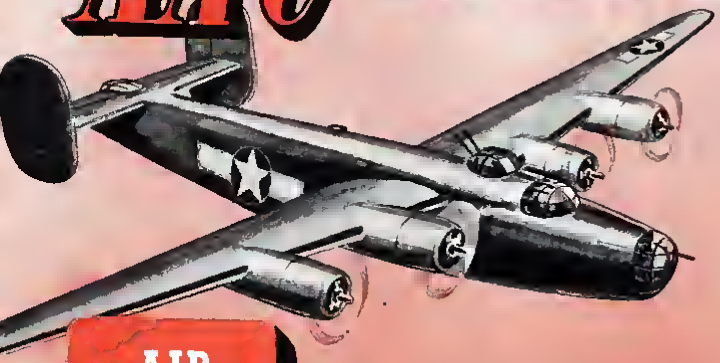
BUY WAR BONDS AND SPEED VICTORY

AAC ENGINEERED POWER CONTROLS



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Brake control valves and other hydraulic actuating equipment for military and commercial aircraft.

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Hydraulic engine, clutch and steering controls for marine craft; also winch controls.

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TODAY, AAC Engineered Power Controls are serving the United Nations in their victorious war effort, as standard equipment on such famous aircraft as the Liberator, Lightning, Vega PV-2, Constellation, Catalina, and others. Important new aircraft, now in the making, also will be equipped with hydraulic controls engineered and produced by AAC.

TOMORROW, AAC Engineered Power Controls will be ready to serve a world at peace, not only in the air but on the land and sea, as well. The facilities and know-how that have made us a leading supplier of high precision controls for aircraft, already are at work in developing new and improved controls for commercial motor vehicles, Diesel engines, marine craft, industrial machinery and equipment. *Look to AAC for a solution of your own power controls problems, now and after the war.*

POWER CONTROLS DIVISION
Burbank, Calif.

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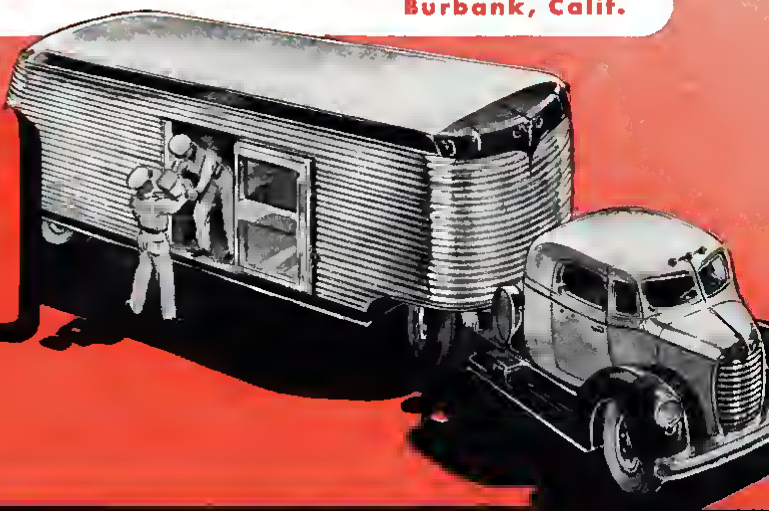
Hydraulic, air and vacuum brake systems for buses, trucks and trailers; Diesel engine controls; controls for hoists, cranes and other industrial machinery and equipment.



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AIRCRAFT ACCESSORIES CORPORATION

ENGINEERED POWER CONTROLS • PRECISION RADIO and ELECTRONICS

Burbank, Calif. Kansas City, Kans. New York, N. Y. Cable Address: AACPRO

Next Time Your Shoes Get Soaked

REMEMBER there are other things besides shoes that can become soaked and heavy.

For instance, the thousands of resilient parts of a plane—oil seals, hose, packing, gaskets, grommets, diaphragms—also may absorb petroleum products like shoes soak up water. And this dead weight not included in the original design calculations may seriously handicap the performance of a plane.

But Hycar synthetic rubber with its light weight and superb resistance to oil to keep it light, provides protection against excessive dead weight not offered by any other comparable material. Hycar is 15% to 25% lighter than many other synthetics, and retains this important quality throughout its long life. Further, oil-swell can be closely controlled to insure dimensional stability of parts.

Hycar has an operating range of −65° to +250° F. and abrasion resistance 50% better than natural rubber. Unlike many other oil-resistant synthetic rubbers, Hycar has a minimum tendency to cold flow after taking the initial deformation, even at elevated temperatures.

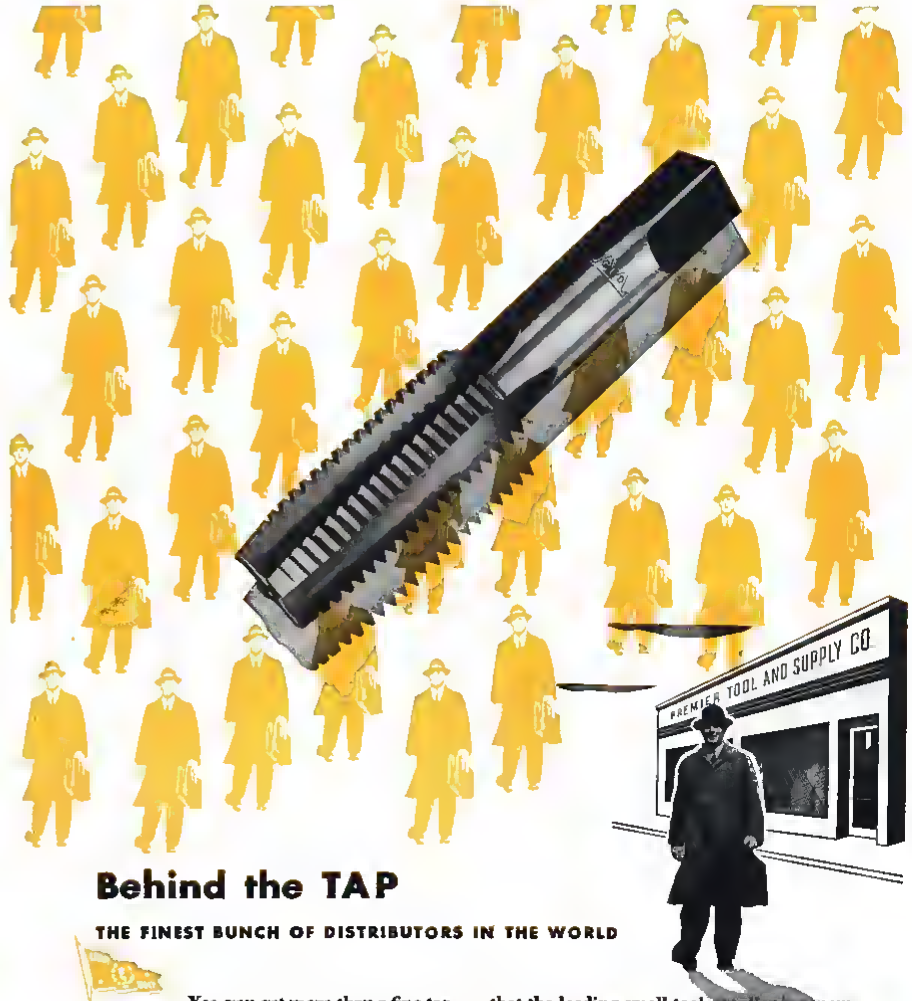
These are qualities you need in resilient materials used in the presence of oil and gasoline. Let our technical service staff help solve your individual problems. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber



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THE FINEST BUNCH OF DISTRIBUTORS IN THE WORLD

Yes, you get more than a fine tap when you specify "Greenfield"— and one of the most important *plus values* you receive is the "on the spot" service of Greenfield Distributors. Your local "Greenfield" Distributor carries a complete stock. He can be at your side in a few minutes. In nearly every industrial center in America you will find that the leading small tool supplier is a member of the nation-wide "Greenfield" distributing organization, devoted to helping you solve your production problems.

Yours For Better Threading

GREENFIELD

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BETTER "ODDS"

FOR OUR FIGHTERS!

Licking the ice menace gives our fighters the advantage of greater safety, and the ability to carry on the fight in foul weather as in fair. Ice on wing and tail surfaces can be removed, as it forms, by flexible ice boots or heated surfaces. Ice on the propeller is another matter. But this threat too, has been largely eliminated by the Adel anti-icer unit. This device applies a measured flow of anti-icing fluid to the prop blades. At the turn of a dial the pilot governs the flow from 1.25 gallon per hour to 30. Power for this pump comes from a specially engineered Dumore motor, built into the unit shown below.

COMBATTING the ice menace is one of more than thirty highly important functions assigned to Dumore Aeromotors on today's fighting aircraft. Like the planes they serve, these motors are designed and built to withstand conditions many times more severe than normal. Windings of the highest grade insulated wire are dipped and baked for insulation, and are then "pre-expanded" to eliminate "breathing." Commutator leads are swaged and soldered into the bars. Armatures are balanced statically and dynamically. Shielded ball bearings and bronze-graphite bearings, impregnated with special oil to provide adequate lubrication, insure perfect performance at wide extremes of temperature. Special brushes assure proper commutation at high levels and low air-pressures. Finally, Dumore "design modifications" integrate the elements of the drive mechanism with the motor itself, assuring sustained durability. Read the complete, interesting story of Dumore Aeromotors in our motor catalog. Ask for a copy today! Write the Dumore Company, Motor Division, Dept. MF15, Racine, Wis.

The Anti-Icer Unit

The Adel anti-icer unit combines a precision metering pump and a Dumore in-built motor. The unit is provided with rheostat control and operates much of the time at reduced speeds for low pump output. An essential requirement is extreme stability of speed, at low speeds. A definite maximum current drain at maximum pump output is established, which must not be exceeded. With such details in mind, it is noteworthy that Dumore motor parts were selected to power this unit.

THREE OF MORE THAN THIRTY DUMORE AEROMOTORS

Dumore Type A2X explosion proof motor designed for anti-icer pumps, de-icer distributor valves, pumps and blowers.

Dumore Type E1Y2PBSR motors are used to operate cowl flaps and oil cooler flaps to prevent excessive temperatures of oil and main engines.

Dumore Type E1Y2PB motor, actuating oil cooler flaps and intercooler flaps. Prevents excessive temperatures in oil and supercharged air.

FOR *Extra* POWER HOURS

DUMORE

HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS

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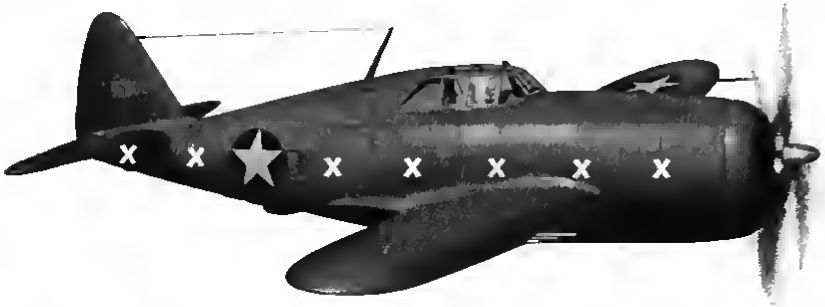
. . . does not mean that Allied aircraft won't be knocked down by enemy planes or ack-ack. But it does mean that our pilots can be sure they're flying the best planes that Yankee know-how can produce.

U. S. plane makers depend upon x-ray inspection—a fast, accurate non-destructive method—to test the hundreds of weldments and non-ferrous castings used in modern fighting planes, because it provides important visual evidence which can be correlated with physical tests. In combination with stress analyses, for example, x-ray examination enables plane designers to predict a part's ability to withstand a static load or repeated reversals of loading.

There is available a complete line of G-E Industrial X-Ray Units in a wide variety of types to meet every aircraft inspection need. For full information as to which unit will best meet your requirements, write or wire today to Department N-86.

In one plant a G-E Industrial X-Ray Unit inspects 204 supercharger buckets simultaneously in one minute thus insuring flawless parts in final assembly, and inspection keeps ahead of production.



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For half a century, The Cleveland Pneumatic Tool Company has devoted itself to serving many major industries * Skilled technicians and experienced engineers within our organization have pioneered and perfected many products for each of these fields. Thus initiative and resourcefulness have enabled us to keep abreast of this country's remarkable industrial progress . . . We are commemorating our golden anniversary by continuing to put all our talents and energies in the fight to preserve the American way of life. We are proud to have grown with our nation for 50 years, and look forward to serving in the great future that lies ahead.

**CLECO Pneumatic Tools speed production in metal-working plants. AEROLS (the shock absorbing landing gear used so universally on aircraft) insure safe, smooth landings and take-offs. CLEVELAND Rock Drills are widely used in the mining and contracting fields. CLE-AIR Shock Absorbers protect buses, trucks and trailers from road shocks.*

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In this modern aircraft engine plant, very definite economies have been effected in the finishing of crankcases through the use of automatic equipment, developed by Mahon engineers. Manual handling is almost entirely eliminated. Crankcases flow in a continuous stream past the painting positions and into and through the 4-compartment baking oven, automatically regulated to exact baking heats. A material saving in floor space has been achieved by locating the oven ten feet above floor level. As a protection to operators' health and to insure faster, better work, the paint room is completely air-conditioned. A specially developed ventilating system floods and exhausts this room more than 70,000 cubic feet of filtered and heated air per minute. So free is the air from overspray and fumes, women operators work without masks and in lightest colored clothing . . . Mahon engineers can modernize and economize YOUR finishing operations with equal efficiency. Let us show you how and why.

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TWO OR FOUR PLACE?

Write your own Ticket...

WE'LL BUILD THE POST-WAR PLANE YOU WANT!

WE intend to plan our Bellanca planes for post-war tomorrow according to *your* ideas of what *you* will prefer to fly as pilot —or fly *in* as passenger. And so we've listed a number of questions, which seem to us pretty fundamental, in our Aircraft Quiz.

Make no mistake about it, we're placing first things first. We're doing our share to win the war. Work at the Bellanca plants has been devoted to building the twin-engined AT-21-BL crew trainer, as well as vital Army Air Forces warplanes armament and components. Like yourself, we've gone all-out for Victory. But we're also planning for your *peacetime* needs.

Our Aircraft Quiz has brought out the views and opinions of thousands who are looking ahead to post-war flying. This Quiz covers many important features in the design, construction and economical operation of tomorrow's private planes. It goes into speeds, range, weights, and loads—flight characteristics—types of construction — your personal experience in flying—and many other questions that will help you in choosing the aircraft best suited to your peacetime plans. And these questions are so arranged that you can quickly check them off—*Yes* or *No!* Then, later, we'll send you the score-card of this Quiz.

You'll find the Quiz most interesting. Possibly it will help you to clear your own thinking. And your answers will help at least one aircraft builder to supply the kind of peacetime plane *you* want. So—send us your name and address today and we'll mail the Aircraft Quiz promptly....Bellanca Aircraft Corporation, Dept. S-3 New Castle, Delaware.

BELLANCA

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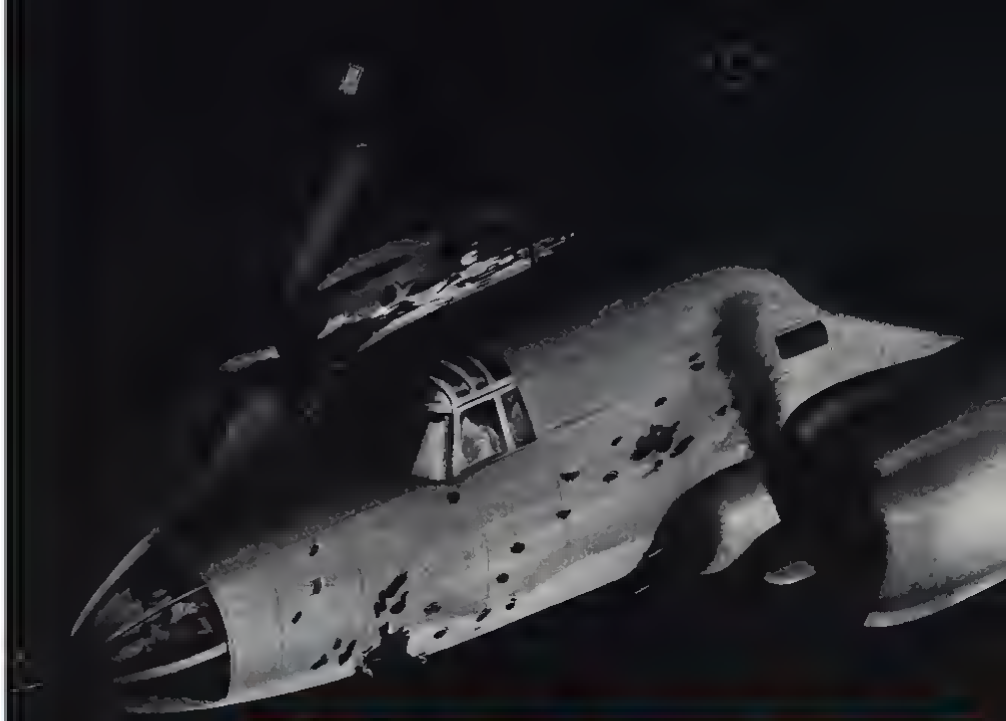
U. S. WAR BONDS

Maytag Hydraulics

are easy to service in the field

FOR MANY YEARS the world's leading manufacturer of domestic clothes washers, The Maytag Company, Newton, Iowa, is now devoting all of its efforts to the manufacture of a full line of Hydraulics of exclusive design ... together with Eclipse electrical retracting units ... and many types of aluminum alloy aircraft castings.

Maytag



A WING . . . A PRAYER . . . AND *Controlled Quality*

• Riddled by flak...crew exhousted...yet confident thot we on the home front—in producing Ladish controlled quality aircraft forgings—are daing our part to bring them safely hame.

TO MARR PROGRESS

ARMY E NAVY

LADISH DROP FORGE CO.

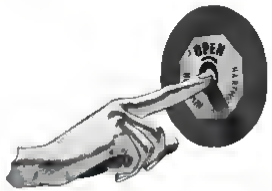
CUDAHY • WISCONSIN

MILWAUKEE SUBURB

NOW! A flush door lock for aircraft

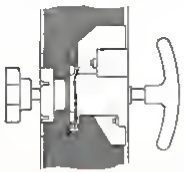
Projecting door handles are eliminated by the new Hartwell flush door lock. It presents a smooth, flat surface; improves streamlining and aids performance. The lock comes equipped with mounting plate, variable skin-thickness adapter plate, and a key lock, which is built into the push-button control.

Designed for fast warplanes, the new Hartwell flush door lock will be a streamlining *must* on all peacetime planes. Write our Los Angeles office for complete engineering details for this "airage" door lock.



Push-button release. To open the plane door from the outside, the release button is pressed, as shown here. This permits the recessed, octagon-shaped handle to slide forward.

Convenient grip. In the released position, the handle—measuring 3 in across—provides a convenient grip. It can be pushed back into place from the outside, or pulled flush when the door is closed from the inside



Profile of handle. This cutaway view of the Hartwell flush door lock shows how it looks installed. It can be adjusted to doors of varying thickness by lengthening or by shortening the inner door handle shaft.

PATENT PENDING

The Hartwell flush door lock is shown above in the open position. It is complete with mounting plate and die stamped variable skin thickness adapter plate, flush-riveted to the mounting plate. To install, the airframe builder has only to make a circle cut-out for the adapter plate.

Single source for 779 different aircraft production parts and tools

HARTWELL
AVIATION SUPPLY COMPANY
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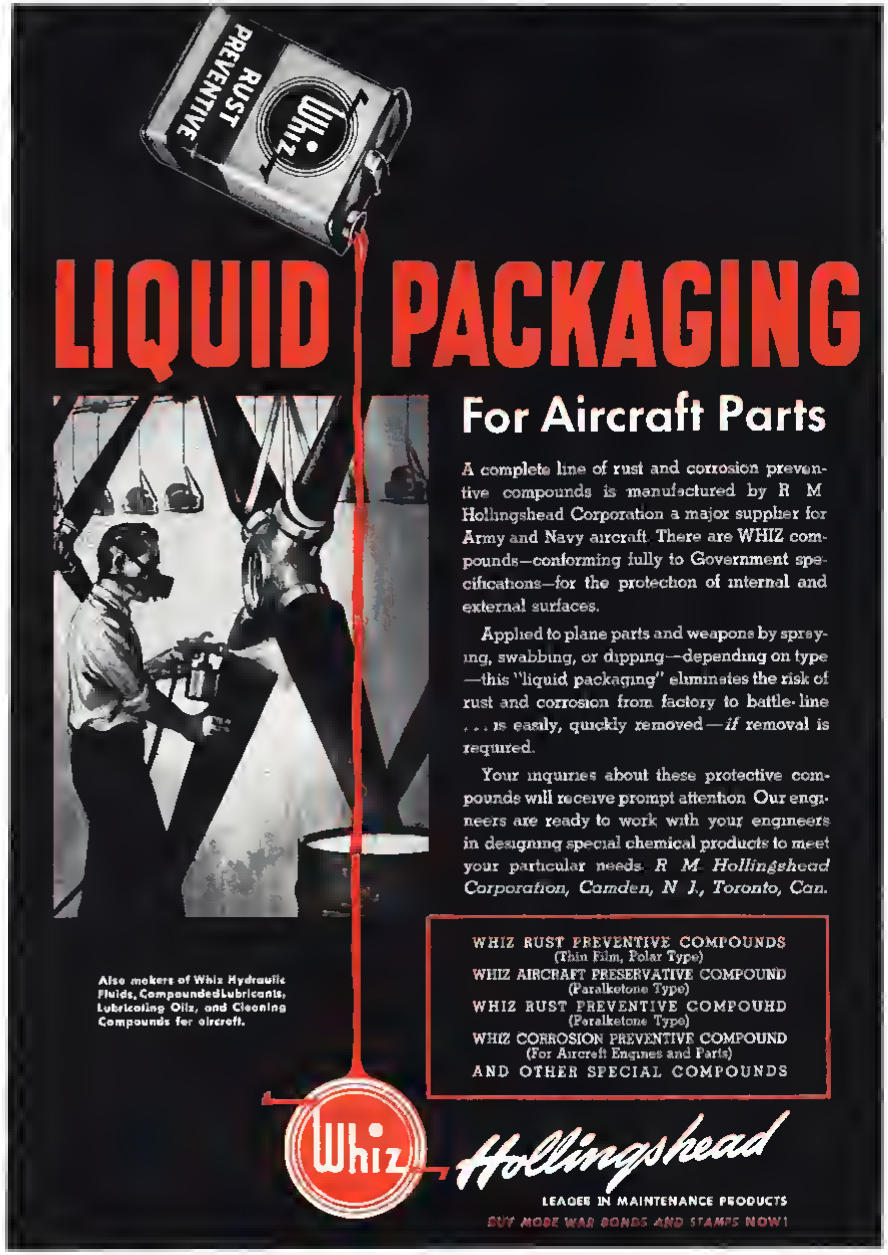
Dallas, Texas • Detroit, Michigan • Kansas City, Kansas



That dynamic progress which says "This is America"! is nowhere so great as in the production of Raybestos friction materials for you. ★ Practically everything that is power-driven on land, sea or in the air requires brake linings and clutch facings for safe, smooth control. And the amazing advancements in the speed, power and performance of this equipment have called for like advancements in the production of friction materials. ★ Raybestos has won leadership in this basic industry. Raybestos advanced friction materials anticipate the ever-changing, ever-challenging requirements of American progress—in their design, their development and their use.

THE RAYBESTOS DIVISION of Raybestos-Manhattan, Inc., BRIDGEPORT, CONN

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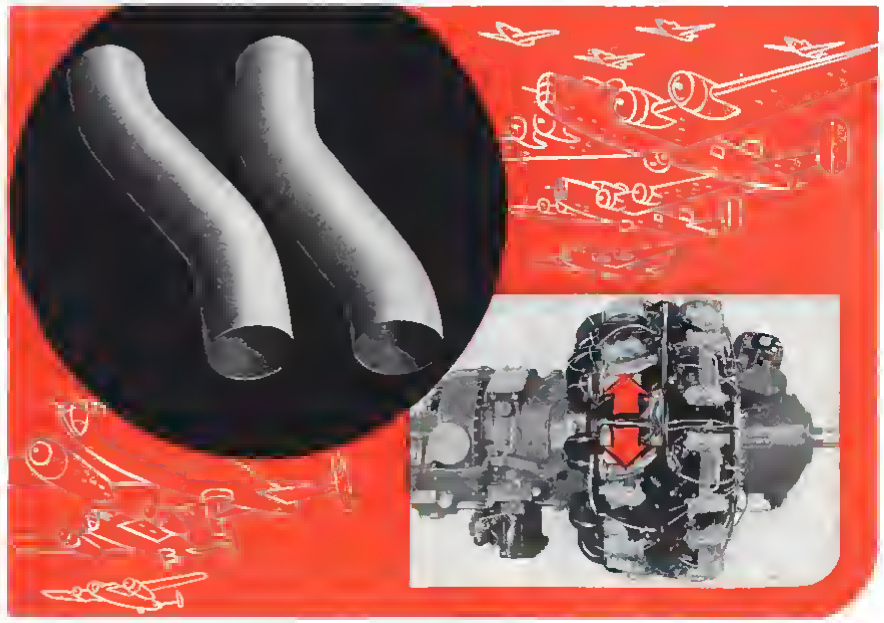
INVEST IN AMERICA BUY BONDS

Manufacturing the most complete line of highest quality metallic and non metallic brake linings and clutch facings for every type of equipment, war and civilian. Also fan belts and hose



STAINLESS STEEL THROATS

for Fire-Spitting Dragons of The Skies

No legendary dragon ever excited more fear in its victims than our fighting aircraft are striking to the hearts of our enemies. To them our bombers and fighters have become fearsome dragons of the skies.

Propelling each of these airplanes through the air is one or more powerful engines, from whose cylinders rush hot, flaming, corrosive gases—spitting fire like the dragons of old.

Only a few materials—among them Enduro Stainless Steel—can withstand the attack of corrosion and oxidation under such conditions for any length of time

That is why Republic ELECTRUNITE Stainless Steel Tubing made of Enduro is used for exhaust stacks on many aircraft engines. On the engine above, this tubing is further protected by an outer sheath, forming an air circulating space for cooling purposes.

ELECTRUNITE Stainless Steel Tubing provides all of the features of Enduro—corrosion- and heat-resistance, ease of cleaning, high strength, eye appeal—plus the uniformity of diameter, wall thickness, concentricity, ductility and scale free surface provided *CONSISTENTLY* by the ELECTRUNITE process.

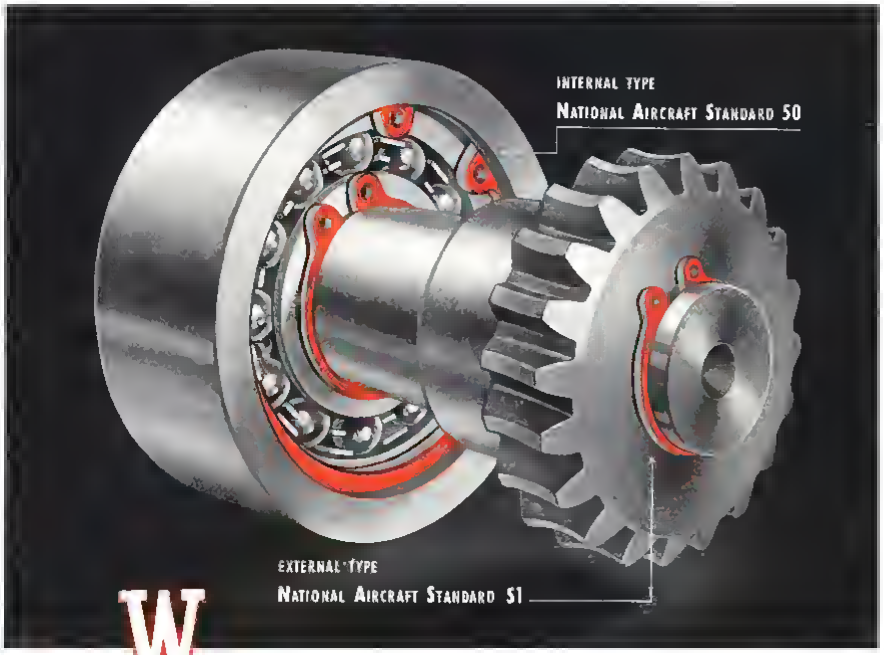
It may be the very material you need to improve your product. Write us for detailed information.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION - CLEVELAND 5, OHIO
Berger Manufacturing Division
Culvert Division ▪ Niles Steel Products Division
Union Drawn Steel Division ▪ Truscon Steel Company
Export Department, Chrysler Bldg., New York 17, N. Y.

CARELESS TALK MAY COST LIVES. BE CAREFUL IN DISCUSSING WAR INFORMATION

Republic
ELECTRUNITE
STAINLESS STEEL TUBING

Also Carbon Steel Mechanical Tubing — Aircraft Tubing — Boiler, Condensar and Heat Exchanger Tubes



Waldes Truare presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

For thrust-load fixing, and shaft and housing applications, Waldes Truare provides distinct advantages over nuts and bolts or wedges and washers . . . it reduces dimension and weight . . . saves material . . . cuts manufacturing time . . . simplifies assembly and dis-assembly. On request, we will gladly furnish samples and full data for your tests.

WALDES

TRUARC

RETAINING RING

U. S. Pat. Re 18,144
Sole Manufacturers in U. S. A.

WALDES KOH-I-NOOR-INC. LONG ISLAND CITY-N.Y.

CANADIAN REPRESENTATIVES: Pranse Progressive & Engineering Co., Ltd., 72-74 Stafford St., Toronto

Designed for efficiency

built for endurance

Shorter, more compact, better balance . . . for easier handling and greater convenience in close quarters plus matchless endurance.

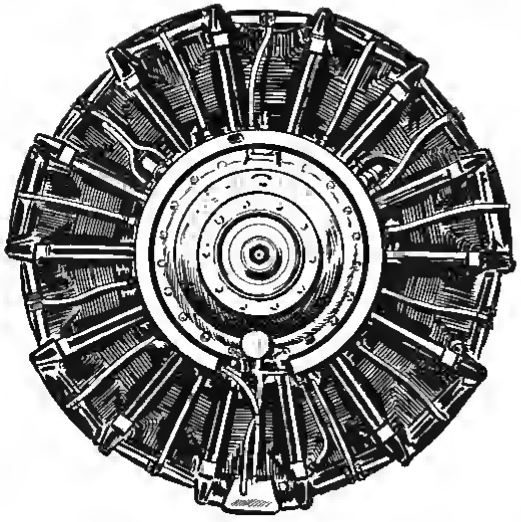
A Size for Every Need . . Heavy Duty 1", ¾", ⅝", ½" (2), ⅜" (2), 5/16", ¼". Special ¼" All Angle.

Write for full details

SIOUX ELECTRIC DRILLS

STANDARD THE WORLD OVER

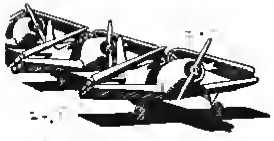
ALBERTSON & CO., INC. SIOUX CITY, IOWA, U. S. A.



Keeping ashes out of aircraft engines

The oxidation of metal is actually a slow, burning process. The "ash" formed from this burning is the red-brown, crusty material familiarly known as rust.

Early in the war, rust sometimes knocked out 75% of the mechanized equipment before it could be



used in combat. Internal rusting in aircraft engines was a particularly serious problem. Mere protection from the elements was not enough, as temperature changes caused moisture condensation from the air inside cylinders, on valves, pumps and other machined surfaces.

One of the outstanding products developed in answer to this need was Stop Rust B.

Stop Rust B—a development of Union Oil Company—is a rust preventive that is also a lubricant. The engine is operated with Stop Rust B blended with the regular aero oil, for a short time, automatically spreading the rust-preventive lubricant to every internal part, thus sealing the metal against corrosion. It adheres to metal for prolonged periods. Because Stop Rust B is a detergent as well as a rust-preventive lubricant, engines operated on it remain clean and free from sludge.

For a supply of this revolutionary new rust-preventive lubricant telephone your Union Oil Resident Manager, or write Union Oil Company, Los Angeles, California.

Remember—Stop Rust B is easy to use—keeps the engine clean and ready for immediate operation.

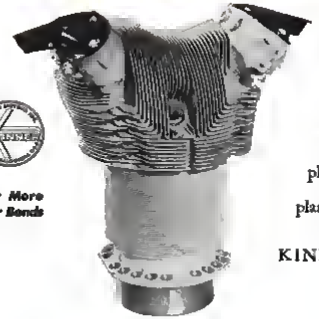
STOP RUST B

Another
UNION OIL
Success-Tested Product

HEY BUD, LISTEN TO NO. 3 REV UP!
SHE SOUNDS LIKE A NEW ENGINE

No 3, and thousands of other aircraft power plants, have the full-throated roar of *new* engines after maintenance crews install new cylinder and cylinder head assemblies built by Kinner. Under contract to the U S government, Kinner builds complete assembly units for 1200 hp Wrights—run-in and dynamometer-tested—perfectly matched for quick replacement at air maintenance depots all over the world. That job calls for precision workmanship, accurately controlled testing, extreme care in packing and shipping—. . a challenge successfully met by Kinner production skill.

Kinner engines power Fairchild, Meyers, Ryan and Howard training planes. Kinner will serve America and the world with all types of power plants when Peace comes.



Complete Kinner-built cylinder assembly used in engines that power our fighting aircraft.

Buy More War Bonds

KINNER MOTORS, INC. ✯ Glendale, California ✯ U S A

Kinner

1919—BUILDERS OF DEPENDABLE AIRCRAFT ENGINES FOR A QUARTER CENTURY—1944

How to Make Each of 328 Fostenings Carry an Equal Share of the Load

Each wing of a DC-3 transport plane is fastened on with 328 nuts and bolts.

Unless the stress and strain are distributed equally, some of the bolts shear off.

The answer was found in Elastic Stop Nuts. These nuts can be given precisely the right tension —then lock fast.

This is one of the important structural fastening jobs which Elastic Stop Nuts have solved.

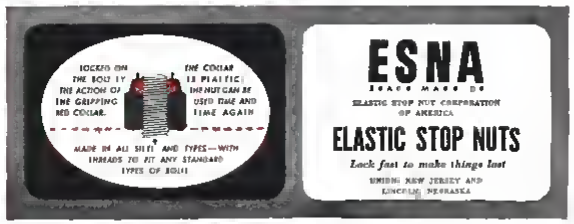
We've been told Elastic Stop Nuts, by solving many such structural fastening problems, have revolutionized aircraft construction.

These nuts lock fast—are safe. They stay tight and secure even in the face of unusual vibration. That's why they are approved for fastening such vital parts of an airplane's structure.

It's the elastic collar that does the trick. It molds itself to the bolt threads and grips them tight. The nut can't jiggle loose.

After the war ESNA nuts with the red collar will be ready to do the hard jobs of peacetime production.

Any fastening problem you anticipate will be welcomed by our engineers. They are ready to help you solve it and recommend the proper Elastic Stop Nut.



Most significant contribution to safer take-offs and landings was the development by Douglas of the tricycle landing gear and its use on large aircraft. Thus were the hazards of ground loops and noseovers eliminated.

Adapted to the Douglas Dolphin in 1936, the tricycle gear was next used on the mammoth B-19, the DB-7 Boston, the A-20 Havoc, the DC-4 and the C-54 transports.

Altho an independent development by Douglas, full engineering data on tricycle gears was available to other manufacturers, resulting in safer take-off and landing characteristics for many planes

DOUGLAS EQUIPPED AIRLINES: American Airlines — Hawaiian Airlines Ltd. — Braniff Airways — Chicago & Southern Air Lines — Colonial Airlines — Delta Air Lines — Eastern Air Lines — Western Air Lines — Northeast Airlines — Northwest Airlines — Pan American Airways — Pennsylvania Central Airlines — TWA — United Air Lines — China National Airways — Pan American Grace Airways — Aviaco (Aerovias Nacionales de Colombia) — Cia. Mexicana de Aviacion — Panair Do Brazil — Cia. Nacional Cubana de Aviacion S.A. — Urabe Medellin and Central Airways — Ervenia de Sul (Brazil) — Primeras Lineas Uruguayas de Navegacion Aerea S.A. — Aerovias de Guatemala S.A. — Canadian Pacific Airlines — Australian National Airlines — Royal Dutch Airlines (K.L.M.) — Royal Netherlands Indies Airways (K.N.I.L.M.) — Sabena (Belgian Congo) — Swissair (Switzerland) — A.B. Aerotransport (Sweden) — Indian National Airways — L.A.P.K. (Spain) — Aer Lingus (Ireland) — American Airlines of Mexico — British Overseas Airways (BOAC) (England)

NOW—you can have "MX" cushion cutting action in WHEELS... MOUNTED WHEELS...STICKS

Removing run-out fin and polishing threads on worm gear.

Burring and chamfering two edges simultaneously on flame cut parts.

Burring operation on all surfaces of clutch plates fed four at a time into stack of thin tapered wheels.

IN 1942 "MX" Wheels, a development by Carborundum Engineers, were introduced for the removal of disturbed metal. Two years of use by industry in manufacturing a variety of metal parts has demonstrated their unusual qualities.

Cushion Action. Fast and effective with elimination of vibration and chatter.

Self Cleaning in addition to clean cutting: An "MX" wheel rarely loads up even when working on the softer metals or alloys.

Versatile. The wide range of operations on which "MX" is being used proves its adaptability to broad industrial application.

Safe Operation: The unique combination of abrasive grain, fibre and bonding material gives "MX" its high tensile strength.

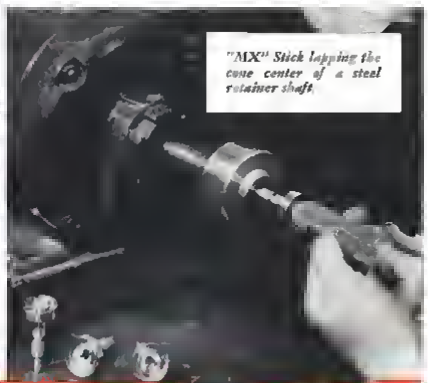
Long Life and Re-Use. "MX" Wheels may be combined in groups and re-dressed for re-use on other than their original operations.

IN 1944 Now, "MX" Mounted Wheels and Sticks are also available to industry. These new tools make possible a broader industrial application of the product.

"MX" Mounted Wheels are ideal for grinding and finishing those hard-to-get-at-spots . . . and "MX" Sticks are unusually efficient for hand use on spinning work—for finishing and polishing.

"MX" IN ACTION—*These action shots demonstrate a few of the innumerable operations where the fast, smooth action of the "MX" Abrasive Tools are helping to turn out* better parts in less time.

(Carborundum and "MX" are registered trade marks of and indicate manufacture by The Carborundum Company)



"MX" Stick lapping the cone center of a steel retainer shaft.

"MX" Products
TRADE MARK

THE CARBORUNDUM COMPANY, NIAGARA FALLS, NEW YORK

by CARBORUNDUM
TRADE MARK

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids, St. Louis, Buffalo

Classroom for Combat

The feel of the fight is built into the Fairchild "Gunner"—an aerial classroom for combat equipped much like those planes that will fly in the assaults on Tokyo.

Fairchild engineers are expert in designing aircraft to do specific jobs well. So, when the Army foresaw the need for a plane with bomber characteristics to train its sharpshooters of the air, Fairchild built the "Gunner." The men who will ultimately loose "squirts" of death into enemy pursuits and interceptors, today can sharpen their skill in a plane that gives them the *feel* of combat operations.

The "Gunner" has twin guns that fire from a power-operated top turret. Its transparent plastic nose houses a manually operated machine gun. Its "office" has controls for pilot and co-pilot. And in landings and takeoffs, the "Gunner" rolls, like the heavies, on a retractable, tricycle landing gear.

With its two 520 horsepower Ranger V-Twelves for power; with its sleek rivetless surfaces of plastic-bonded plywood fabricated by the famed Duramold process; with the aerodynamic stability inherent in all Fairchild designs, the "Gunner" flies with the Fairchild "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft *Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland—Burlington, North Carolina*

This is Not a New Motor

. . . But — this is the first time we have advertised our TYPE OG standard open squirrel cage motor.

These motors have been giving a splendid account of themselves in the war program for over two years.

A complete line is available—¾ to 100 HP in D.C. and ½ to 500 HP in A.C.

A copy of our new bulletin fully describing the quality features of TYPE OG motors will be sent upon request.

THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.

There are many GOOD THINGS AHEAD . . .

Fins applied to the sides of aircraft tires have been found to reduce wear. When the landing gear is lowered, the air pressure spins the wheels and reduces the scuffing of the tires in their first contact with the ground.

The formerly worthless scrub palmetto, which grows like a weed on the Gulf Coast of Florida, is now ready to supply material for wallboard, brushes, binder twine, upholstery, insulation, and for use as a reinforcement for plastics and Portland cement.

A plastic molding powder is being made from potato starch.

Some engineers foresee the time when the refuse of cities—garbage, ashes, paper, etc.—will be removed continuously by underground tubes and burned in large incinerators to furnish power.

Shells are being tested by a new variation of the old trick of dropping a coin on the counter. When dropped on metal plates, the perfect shells make a particular sound that is detected and reported by an electronic "ear."

A fine finish may be put on stainless steel inexpensively by means of a newly patented electrolytic process.

The strength of spot-welded aircraft joints is being successfully tested by X-ray.

Because of its peculiar stretch and slow recovery, as well as its light weight and resistance to rot, Nylon rope is expected to have many postwar uses where a shock absorbing effect is required.

A new flexible tubing is made of woven glass fiber covered with plastic.

A new street cleaner sucks up leaves and compresses them for fertilizer.

A new ignition cable is made of monel and is insulated with synthetic rubber and glass fabric.

Pure tungsten can now be produced directly from the ore by a newly reported electrolytic process.

A patent assigned to a large truck manufacturer permits the conversion of a regular truck to a half-track crawler.

The Office of War Information has an exhibit of new materials, methods, and products in the Social Security Building in Washington.

Echo sounders, intended to measure the depth of water under a ship, are being used to locate schools of fish.

Experiments are being made with alloys of wrought iron and nickel.

Machinery has been designed for the high-speed, mass-production baking of bread with infra-red lamps.

Neon lights will be standardized in 98 colors.

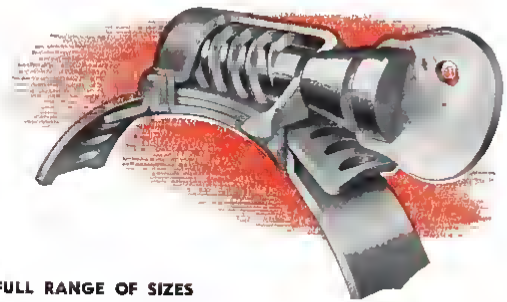
Several manufacturers of air-conditioning equipment are working on plans for a $1,000 unit suitable for a six-room house.

At least 30 aircraft parts of laminated plastic paper are in production.

Lamp bulbs are being made shatterproof by a coating of lacquer.

A new double-barrelled spray gun that can handle two fluids at once has just been patented.

A novel mail box answers audibly any spoken request for the zone number of any address in the city.

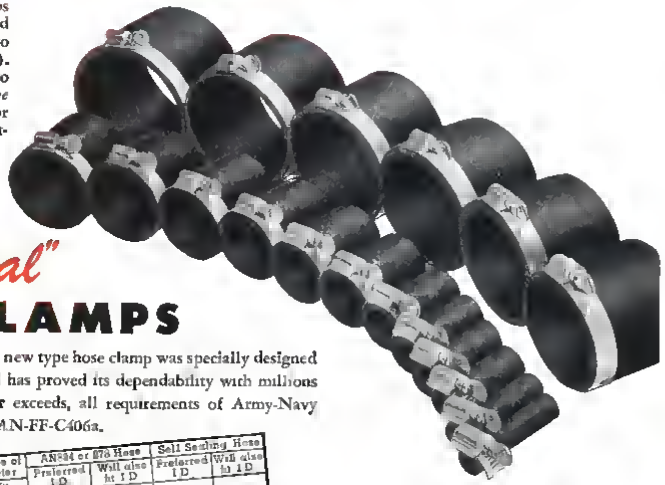


WORM GEAR ACTION

This break-away picture shows the AERO-SEAL action . . . like a worm and worm gear. It gives, in compact space, a belt-like tangential tightening action which assures uniform pressure around the entire periphery. AERO-SEAL Hose Clamps hold tight *without lock wire* under severe vibration, as proved by authoritative tests.

FULL RANGE OF SIZES

AERO-SEAL Hose Clamps are now made in 18 standard nominal sizes from ½" to 4¼" (approx. hose O.D.). Larger sizes can be made to order. These clamps *can be re-used* and can be put on or taken off without disconnecting hose from pipe.



"Aero-Seal" HOSE CLAMPS

This outstandingly successful new type hose clamp was specially designed for aircraft applications, and has proved its dependability with millions now in service. It meets, or exceeds, all requirements of Army-Navy Specifications AN-748 and AN-FF-C406a.

QS100 Dash No.	Nominal Clamp Size	Extreme Range of Clamp Diameter Max	Min	AN884 or 878 Hose Preferred I.D.	AN884 or 878 Hose Will also fit I.D.	Self Sealing Hose Preferred I.D.	Self Sealing Hose Will also fit I.D.
M4	⅜	11/16	⅝	5/16 & ⅜	½		
M6	⅝	1 1/16	½	5/16 & ⅜	⅝		
M8	¾	1 5/16	⅝	7/16 & ½	¾		
M10	⅞	1 7/16	¾	½	⅞		
M12	1	1 11/16	1 1/16	⅝ & ¾	1		
M16	1¼	1 27/32	1 5/16	1	1¼	1	1¼
M20	1½	2 3/32	1 9/16	1¼	1½	1¼	1½
M24	1¾	2 11/32	1 13/16	1½	1¾	1½	1¾
M28	2	2¼	2 1/16	1¾	2	1¾	2
M32	2¼	2½	2⅜	2	2¼	2	2
M36	2½	2¾	2⅝	2¼	2½	2¼	2½
M40	2¾	3	2⅞	2½		2½	
M44	3	3¼	3 1/16		3		
M48	3¼	3½	3⅜	3			
M52	3½	3¾	3⅝				
M56	3¾	4	3⅞	3½			
M60	4	4¼	4 1/16				
M64	4¼	4½	4⅜				

SIZE, TAKE-UP, & HOSE DIA. DATA

This table lists the standard sizes of AERO-SEAL Hose Clamps, the take-up available on each size, and the hose sizes (AN884, AN878, or self-sealing type hose) each will fit. Note that the diametral take-up is, in most instances, more than double the amount required to cover variations in hose diameter, wall thickness, and the flow of rubber under repeated tightening of clamps in service. For easy, uniform, reliable tightening and elimination of leakage at high pressure, use AERO-SEAL Hose Clamps. *Write for samples.*

Aircraft Standard Parts Co.
1715 Nineteenth Avenue, Rockford, Illinois

Lowdown... on a HIGH-PRODUCTION team

MULT-AU-MATIC

VERTICAL TURRET LATHE

A Bullard Type "D" Mult-Au-Matic and a Bullard Vertical Turret Lathe turn out airplane engine parts for a famous American builder

The productive genius of America's builders of airplane engines is nowhere more forcefully evidenced than in the wide use it is making of these two Bullard machines. The unique quality of both of these tools is that they spend *more* time each day in working . . . because *less* time is lost in chucking. On many operations, indeed, they have cut production time to one-third less then the former time of outdated methods. Write today for an estimate.

NEWS FLASH!

Investigate the New Heavier, Larger 34" Mult-Au-Matic

For work 34" in diameter and 23" in height write for specifications of this new machine. You'll be surprised at the many new features

THE BULLARD COMPANY
BRIDGEPORT 2, CONNECTICUT, U.S.A.

NOW—

FOR AIRCRAFT ENGINES!

SEALED POWER

INDIVIDUALLY ENGINEERED

PISTON RING SETS

The principle of ring sets individually engineered for each particular engine, so outstandingly successful in the automotive field, is now being applied to the replacement needs of the aviation industry by Sealed Power engineers.

Individually Engineered Ring Sets have been developed for the following aircraft engines:

Continental	**A40, A40-5, A50, A65, A75, A80**
Lycoming	**O-145**
Franklin	**4AC, 150, 171, 176, 199**

Sealed Power jobbers are now prepared to furnish these fine ring sets to flying fields from coast to coast.

SEALED POWER CORPORATION

Muskegon, Michigan • Windsor, Ontario

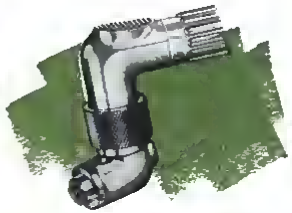
SEALED POWER PISTON RINGS

PISTONS—CYLINDER SLEEVES

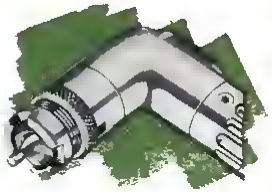
TOOLS FOR *TIGHT* SPOTS

45° or 90° Standard Angle Drill with 10-32 or ¼-28 threaded nose spindle . . . patented Thumb Pad Safety Grip

45° or 90° Jumbo Angle Drill takes up to ½" drills with ¼-28, 5/16-24, or ⅜-24 spindles with taper.

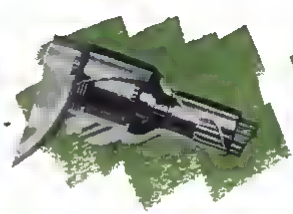


360° Standard Angle Drill swivels in 360° arc, locks automatically in 16 positions. Direct or flex drive



Stop Countersink for standard angle drill where countersink and depth must be controlled. Length 2 1/16".

Pork Chop Angle Drill is a convenient, low cost hand holder type driven by grease packed universal joint.

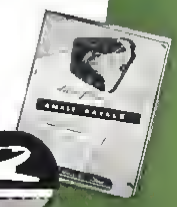


Angle Drill Support gives better leverage, prevents bending of angle drill shaft or dropping of drill from driver.

45° or 90° Flex Drive Angle Drill equipped with 30" flexible shaft with ⅜" steel core, rubber covered casing

☆ *Complete Repair Service for All Types of Aircraft Tools!*

Write for complete information in new Angle Drill Folder!



Aircraft TOOLS, INC.

DALLAS 8, TEXAS • LOS ANGELES 1, CALIFORNIA • DETROIT 2, MICHIGAN

• Reg. U. S. Pat. Off.

As wave after wave of low-flying Liberators made a shambles of Ploesti, American airmen gave history a fresh chapter. Official Photo U. S. Air Forces .... Ploesti mission—Astra Romana Refinery.

. . . AT THE FUTURE "PLOESTIS"

EVERY red-blooded American hopes for many more headlines that shout "Mass Raid by American Liberators." Every solid punch these heavyweight fleets drop on enemy targets . . . every future "Ploesti" . . . is possible only through the courage and skill of the American kids that fly them, and the unceasing work of free American craftsmen who build them.

With millions of other war workers, the men and women of CECO look forward to each new record-smashing performance of the latest Liberators and other American warplanes equipped with CECO carburetors and fuel pumps.

CECO

CARBURETORS

FUEL PUMPS

PROTEK-PLUGS

CHANDLER-EVANS CORPORATION SOUTH MERIDEN CONNECTICUT, U. S. A.

They're getting their bearings . . .

WHAT HAPPENS TO OSTUCO SEAMLESS STEEL TUBING IS COUNTED IN MILLIONS AND MEASURED IN MILLIONTHS!

Millions of bearings—often precision refined to millionths of an inch—demand the highest degree of quality in all materials in order to provide their near perfection in mechanical operation. OSTUCO contributes to that high standard through the seamless steel tubing it supplies (Photo courtesy of Bower Roller Bearing Co.)

"A steady stream of planes flew over the invasion coast for several hours"—such is the typical radio report—your industrial answer to the blitz type of warfare our great American forces are continuing to deliver.

OSTUCO seamless steel tubing is used by many manufacturers as a part of the reliable aircraft and heavy duty military motor vehicles they produce . . . equipment that is blueprinted for utmost accuracy and unfailing ability, in support of our fighting men who must trust their lives on its performance.

Prominent in this group are bearing manufacturers. They approve of OSTUCO seamless tubing because it meets strict military and naval specifications; because it has the machining properties necessary to provide the accuracy, dependability and durability required in precision bearings which constantly guard against friction and power losses; and because every foot of OSTUCO seamless steel tubing is a symbol of *SPECIAL QUALITY!*

OSTUCO—meeting fast changing methods in the manufacturing world—is gaining new experience day by day as a supplier to top-notch industry. In the change-over from war to peace, this experience can serve you well in an again competitive market.

THE OHIO SEAMLESS TUBE COMPANY

MANUFACTURERS OF SEAMLESS AND ELECTRIC WELD STEEL TUBING

SHELBY OSTUCO OHIO

A WORLD 60 HOURS WIDE

Delco-Remy Aircraft Electrical Equipment

Youth today beholds a world only 60 hours wide. It is a world where age-old concepts of distance and time have been broken down, and remote lands stand at the front gate. ¶ The planes that have wrought this change are now battling for freedom in tomorrow's world. Then, as now, Delco-Remy equipment will serve them with utmost dependability. ¶ Delco-Remy starting, lighting and ignition will bring new convenience and dependability to private planes, and larger Delco-Remy equipment now serving on medium and heavy bombers will enhance the efficiency and usefulness of passenger liners and cargo freighters. Today, more than half of Delco-Remy's production facilities are engaged in the manufacture of electrical units, precision parts and products for the aircraft industry.

ARMY-NAVY E

DELCO-REMY

WAR BONDS WILL BRING THEM HOME SOONER

DIVISION, GENERAL MOTORS CORPORATION

Something New

HAS BEEN ADDED TO THE

HANSEN LINE

IN LINE WITH OUR POLICY of keeping a step ahead of the times, Hansen engineers have developed four new airline equipment items, each of which fill a long felt want.

HANSEN ACETYLENE COUPLING comes complete with socket and plug. Socket has left hand thread and plug has left hand swivel nut on one end. Easy to install, easy to operate. Slight movement of the sleeve is all you have to do in order to connect and disconnect. When connected gas is automatically turned on and coupling is absolutely leakproof. When disconnected gas is automatically turned off. No wastage of gas.

HANSEN ACETYLENE HOSE CLAMP has two grips instead of one inside and outside of hose. Easy to install, requires no special tools and can be used many times over. Swivel nut has left hand thread.

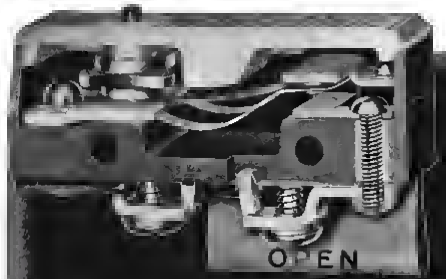
HANSEN OXYGEN COUPLING consists of socket and plug. Socket has right hand thread and plug comes with right hand swivel nut on one end. Easy to install, easy to operate, slight movement of sleeve is all that is required to connect and disconnect. When connected oxygen is automatically turned on. When disconnected oxygen is automatically turned off. Coupling is absolutely leakproof.

HANSEN OXYGEN HOSE CLAMP has two grips instead of one inside and outside of hose. Easy to install, requires no special tools and can be used many times over. Swivel nut has right hand thread.

THE

HANSEN MANUFACTURING CO.

1786 EAST 27th STREET • • • • CLEVELAND, OHIO



MICRO SWITCHES

Have Been Generally Adopted by the Aircraft Industry---

Because they are light, small, dependable, precise and have high electrical switching capacity . . .

The Type R 31 Micro Switch uses the three-bladed, beryllium copper spring construction which has proven so successful in the millions of Micro Switches used throughout industry Adaptation to the requirements on aircraft incorporates contact separation of .070" which satisfactorily interrupts highly inductive loads under conditions of extreme altitude Knurled contact surfaces insure positive operation on extremely small loads and minimize transfer of contact material on D C operation

The characteristics of the Type R 31 basic Micro Switch, which have made it an accepted, standard switch, stocked at all Air Depots, have been worked out with the cooperation of engineers throughout the entire industry, as well as the Army Air Corps and the Navy Bureau of Aeronautics

Micro Switch pioneered standardization of this single type of basic switch to be used with a variety of housings and actuators to meet the widely varying conditions on airplanes, as developed by different manufacturers Housings and actuators become parts of the planes and require no deviation permit They are all built to use the standard Type R 31 Micro Switch for ready field replacement

The Type R-31, with pin plunger, as shown here and in the cut-open view

is the simplest form of Micro Switch for use in electrical controls in aircraft The Type R 31 has been successfully used on thousands of aircraft installations which include all types of fighters, bombers, transports, commercial and private planes Size 1 1/16" wide, 1 13/64" high, 1 15/16" long Weight .067 pounds.

Type MB2731A skeleton bracket has definitely controlled pretravel and overtravel—a total of 1/4" Meets Air Corps specifications for Type A-1 and A-2 switches Overall size, with switch 1 3/16" wide, 2 13/32" high, 2 1/16" long Net weight with Type R 31 Micro Switch 14 pounds.

The new type "A" Actuator is of cold rolled steel with cadmium plate finish Movement differential is .031" maximum, operating pressure approximately 6 ounces; pretravel approximately 3/64", overtravel approximately 1/8" Overall size with switch 3/4" wide, 2 13/32" high, 2 17/32" long Net weight with Type R-31 Micro Switch .141 pounds

Type "M" series of panel mounting brackets offer three lengths of threaded stems for easy positioning Operation takes place in first 1/32" plunger travel Overtravel 1/4" or 3/8" is provided Over all size with switch 1 3/16" wide, 2 13/32" high, 2 1/16" long Net weight with Type R 31 Micro Switch 15 pounds

The Type "T" bracket is widely used as a throttle warning switch, singly or in gangs, operated manually or by cams or dogs on cables. It provides a sturdy mount and actuator Size with switch, 1 5/32" wide, 2 5/64" high, 2 27/32" wide. Weight with switch, .173 pounds.

Micro Switch Corporation, Freeport, Illinois

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Made Only By Micro Switch Corporation Freeport, Illinois, U. S. A

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The riveted wing tanks of the Curtiss-Wright giant C-46 "Commando" transport are sealed with Presstite Extruded Fuel Tank and Seam Sealing Tape, Type SMS-50Z, in all riveted seams— meeting Curtiss Process Specification S-367A. Presstite Brush-On Sealer, Type SM-52C, is brushed on over rivets and joints inside of the tanks. In addition, all riveted fuselage seams in the C-46 are made rain-tight with Presstite Extruded Seam Sealing Tape.

This example of the use of Presstite Sealing Compounds by the aviation industry is only one of the many instances where Presstite Sealants have been developed to solve specific problems.

Your sealing requirements may not be as complex as those in the aircraft field where extremes of temperature, variations in pressure, and constant flexing of joints must be overcome.

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THE FORBIDDEN ROOM...

There are only six keys to the door, and the lock is often changed . . . For this is a very private room. It is in the plant of one of America's greatest corporations, and behind the door to this inner sanctum part of the future is being made.

There are literally hundreds of "forbidden rooms" in America today, where the plans, the designs, the mock ups and models are being made for countless new products and machines—from giant electrical power plants, still in the experimental stage, to table model television sets, now a solid post war certainty.

Few outsiders ever enter this inner circle . . . but one of these is the machine tool engineer.

For equally as important today as any brilliant new design is the *cost of manufacture*—and it is here that the machine tool engineer comes in. Leading manufacturing executives know that this factor of cost is going to be more important, in the fast competition of the post-war period, than ever before in history.

It is because of this that Jones & Lamson engineers are being taken into their conferences and their confidences, helping them to plan complete production line set-ups for the day this war ends.

Even more important than the machine tools your company uses is the machine tool engineering that goes with the use of those tools!

JONES & LAMSON
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Manufacturers of Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

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Westinghouse Announces

A NEW HIGH-FREQUENCY STABILIZED A-C WELDER FOR LIGHT RAUBE WORK

The Type WC-AC welder was designed especially for welding thin-wall tubular fuselage members, tubular clusters on engine mounts, landing gear and light sheet metal work—faster and better.

It meets the four major requirements for aircraft welding service

1. Ability to strike and maintain an arc easily over the entire range of [illegible]
2. Easy stepless current adjustment.
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4. High efficiency and power factor.

The new Westinghouse Type WC-AC Welder eliminates the need for "adapting" welders intended for other types of service with their slower and less flexible performance. Superimposed high frequency makes the a-c arc practical on light materials at low currents and boosts welding output. Further, the price of the Type WC-AC welder is comparable with that of regular d-c welders.

For more information on the new Westinghouse High-Frequency Stabilized A-C Welder, call your nearest Westinghouse office, or write today to Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

J 70413

Westinghouse model WC AC Flexarc Welder — high-frequency stabilized—125 amperes (10-200 amperes).

CHECK THESE FEATURES

1. High-frequency arc stabilization permits operator to strike the arc quickly and hold it steady at current settings as low as 10 amperes.
2. Movable core provides very fine stepless current adjustment
3. *Double range* current adjustment for welding of special alloys—results in extremely fine current adjustment from 10 to 70 amperes.
4. Preset current indicator permits adjusting for desired welding current *before* starting
5. Switch-in-handle electrode holder (included in accessories) provides pilot control of the high-frequency stabilizer.

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PLANTS IN 25 CITIES OFFICES EVERYWHERE

A-C WELDERS

THE COST OF *Tomorrow's Peace*

Today peace-loving Americans are united with thirty-three other nations in a common objective of destruction.

Millions of our fine, young men and women find themselves invading foreign lands in order that their own shores may be spared, and their free way of life preserved.

Their sacrifices will be great. Their job will be well done.

But what of the job they will expect of us when they have finished theirs . . . the job of turning their hard-won victory into a lasting pattern of peace?

Can we come up to their great expectation? We must realize that this is the last opportunity of our generation. We must do a better job of it than we did in the Twenties and the Thirties.

We have our backs to the wall, and the scars of World War I and a thirteen-year depression still are upon us. The final test of our way of life is at hand!

As we look over our shoulder into the immediate past, we see little to encourage us. But we also see much to make us pause. We see a tremendous fighting machine, created in a matter of months by the miraculous organization of our resources.

We, the largest of the peace-loving nations, have overnight become masters at the business of waging war. Today, as a result of the co-ordination of industry, labor, and government, we are producing *for war alone* as much as our total normal production for peace.

* * *

We have amply demonstrated our ability to harness the vast productive capacity we possess. Why cannot these resources, which we have organized so efficiently for the destruction of life and property, be directed toward the destruction of the causes of war?

May not the patriotic and emotional strength and the unity of action which have been stimulated for the purpose of winning the war be directed, at least equally well, toward the attainment of world peace and international harmony?

If they are not so directed, what lies ahead but another war? And how can America, in a world that is so rapidly shrinking in size, avoid involvement in *any* of tomorrow's conflicts?

International peace is an ambitious dream and its price is high, but the price of war is even higher. Our world cannot long survive the periodic waste of its human and material resources.

Our country can be the most potent single force in bringing about the international understanding that leads to peace, in developing the unity that will make the most of the ample resources nature has provided everywhere.

* * *

There is no unity in selfishness. There can be no unity if any one of the great powers fails to do its part in determining and eliminating from the world the basic causes of aggression.

These basic causes stem from greed and the suppression of opportunity for individual progress, for self-preservation is the first law of nature.

Mussolini's dramatic march on Rome in 1922 was made possible by disillusioned veterans of World War I who could find no jobs and whose future held no promise. Some of Hitler's most

determined followers came from the same ranks

Men denied the opportunity to make a living, for themselves and for their children, are easy prey to false doctrines and dangerous "isms."

In any realistic appraisal of our domestic problems—economic, labor, racial—it is clear that we can solve them, not by waiting until we reach some utopian accord, but by making a series of compromises. We do this because we know how discord can impair the very roots of private enterprise, self-government, and self-discipline—the essentials of a dynamic democracy.

Similarly, peaceful reconstruction of our world economy depends on the ability of nations to reconcile their differences in a series of working agreements.

If we in the United States want lasting peace and if we want to preserve our democratic way of life, we must take over our full share of the task of initiating these compromise measures. Acknowledging our inescapable responsibility as the greatest economic and military power in the world, we must attempt to insure the free flow of world trade, and develop—with profit for both parties—backward areas abroad as well as at home. And we must do this by making all nations share the responsibility, not by allowing ourselves to be manoeuvered into being an international Santa Claus.

With our allies, we will have to see to it that the devastated portions of the world rehabilitate themselves as quickly as possible, that practicable and realistic trade and economic relations between nations are developed, and that the energies and productive capacities of these nations are set free to function in a climate that is favorable to the growth of free enterprise and individual initiative. As the most powerful economic force on earth, we have the most to gain and the most to lose at the peace table, and we must never forget that with our power comes responsibility.

We cannot hope to solve all of the problems of all nations—nor even all of our own—but our way can become the way for more of the world's humanity. Our strength can become the guiding spirit of the smaller nations.

* * *

In the development of a sound American foreign policy, let us take care not to attempt to control the destinies of other nations. Let us remember that we must set the example of self-determination of independent, free peoples.

Freedom is essential to international peace, and free competition—whether it be between individuals, between businesses, or between nations—is the mainspring, the synchronizer, and the preserver of freedom. For competition always is synonymous with private enterprise.

We are not a covetous nation. We have no territorial ambitions. Our international commercial aspirations are dominated by the conviction that we have a great stake in world unity and world prosperity. We know that we can no longer live apart from other nations and that we cannot ignore the fundamental elements which affect the well-being of other countries.

Our foreign policy must encompass a world of trade, and help develop it.

We dare not blunder in the execution of that foreign policy if the American way of life is to survive. A democracy resolved upon isolation is doomed in the world of tomorrow.

Let us resolve that out of this devastating catastrophe we shall emerge with fuller understanding and greater determination to build the kind of world which can materialize only if this country has the vision and the will to see it through.

We still are free to decide our own fate—still free to shape our own future. We still are free to preserve the liberty and happiness that has made our country the hope of the world.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

A Unified Industry Writes Its Magna Charta

THE recent Los Angeles meeting of the Governors of the Aeronautical Chamber of Commerce of America, was a milestone in the history of aviation in America. Never before has there existed such unanimity in the industry. The Board of Governors of the Chamber is now composed of the presidents of the companies responsible for by far the major part of this country's aeronautic output. This represents 36 percent of America's war production. Thus, action of the Board can importantly affect our whole domestic economy.

Assembled in that great center of airframe production, these men devoted two full days to meetings of the joint Aircraft War Production Councils (concentrating on cooperation in the war effort) and one day in reorganizing the Chamber as an association for long-term planning and delineation of industry policy. Since sound policy is the first requirement of any plan, and since aviation is predominantly a public rather than a private instrument, the Governors unanimously recommended the early formulation under certain guiding principles of a national aviation policy.

Perhaps the most significant aspect was the broad ground on which the group approached the problem. It defined air power as a four-pronged implement, composed of air *forces*, air *bases*, air *transport* and aircraft *manufacture*—a real step forward from the usual connotation of "air power" in the narrower sense of an air striking force. It recognizes the coming of age of air power and forecasts its profound influence on history. Perhaps the best summation of the board's action was this headline in a Los Angeles morning paper: "Air Chiefs Vote Sky Mastery as Peace Guarantee."

HERE WE HAVE a significant action. A group of individual heads of highly competitive companies took time out to analyze the impact of their business on the public interest and to indicate, out of their experience, the means of converting one of the most destructive vehicles of all time into an argosy of peaceful commerce. It is a plan for beating swords into plowshares which reveals the coming of age of aviation.

This action is but one of the unique aspects of the aircraft industry. The brief life-span of its pioneers has seen its growth from a "new-fangled contraption" into "the biggest aspidistra of them all." Unlike the pioneers of the transcontinental railways, who had the full power of government behind them, the aviation pioneers encountered the reluctance of a people bent on peace. Unlike the western pioneers, who exploited the natural resources of a new country, the aviation pioneers created a new technology. They brought this technology from inception to full flower. History will record their performance, in the face of great vicissitudes, as one of its most striking examples of individual initiative and enterprise.

Though pioneers seldom display the capacity to realize the full possibilities of their pioneering, our aviation pioneers *have* forecast the final step in the full utilization of air power.

In appraising the future, they draw upon past experience. They recognize the analogy between sea power and air power. They recall the history of the last half of the last century, when a beneficent sea power in the hands of a free people assured the right of innocent passage to all who proceeded on lawful occasions. Under the protection of this power, over seas trade flourished, peace reigned, prosperity prevailed, world population increased, and the arts and sciences advanced. No millennium was attained, but human progress was greater than ever before in history.

AND NOW, we Americans have created the dominant air power. This imposes on us a great responsibility. If we repeat the performance that followed World War I, allowing this power to escape into wrong hands, we will invite another war. If, however, we conserve this power, for use in conjunction with our own sea and land powers and those of other people of goodwill, we can keep the peace and promote the prosperity of the world. Strategically, there is no corner of the globe in which any combination of forces can successfully overcome us—if we determine to build and to maintain adequate land and sea power and dominant air powers.

Private industry has usually confined its thinking to the exciting game of making money. This war has brought to American businessmen the realization that unless they recognize the public interest and collaborate in it, there won't be any game left to play. The public interest is very importantly the businessman's private interest. It is, more importantly still, the personal interest of the businessman's employees and their neighbors. Public relations programs must call for more than mere news releases—there must be long-term programs of public education. This, in its broadest sense, is one of the major responsibilities of management.

Recognizing this, the Governors of the trade association of the world's youngest major industry took, at Los Angeles, their first step in a new kind of public relations. This new conception, together with the time-tested relationship between the privately owned aviation industry and government, may well set a postwar pattern for other industries.

None know better than the leaders of aviation what dynamic power lies in the technology of change. No industry has such an incomparable record in the control of this technology. No industrialists better understand the responsibility involved. And this is evident! To prevent the airplane, which America created, from becoming a Frankenstein contrivance, America must harness it to commerce.

Leslie E. Neville

—EDITOR

America's Prime Weapon—
CARRIER-BASED AVIATION

By REAR ADMIRAL DEWITT C. RAMSEY, *Chief, Navy Bureau of Aeronautics*

This is the dramatic story of how "one of the most powerful striking forces of the war" got to be that way.

THE NAVY'S carrier-based planes have emerged as one of the most powerful striking forces of the war. In spite of the fact that extra strength requirements are an essential feature of ship-based airplanes, our planes have proved to be more than a match for the enemy.

Our planes and aircraft carriers have met the acid test of battle piling up an advantage of almost six enemy plane losses to our one, in air combat alone. Carrier aviation has definitely established itself as the spear-head in America's westward drive in the Pacific, ranging several hundred miles ahead of surface units to deliver the first devastating blows at enemy island strongholds.

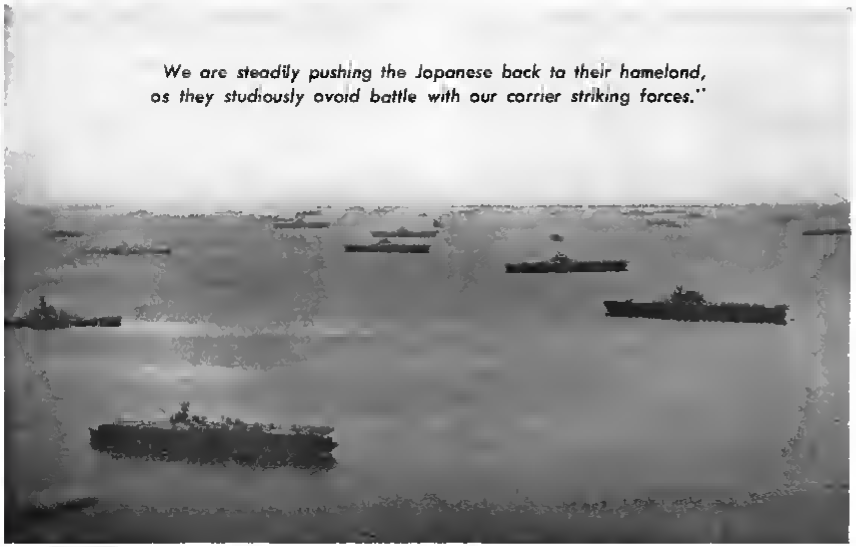
This overwhelming air superiority is even more impressive when one considers that we are pitting our carrier planes against the enemy's land-based fighters. Many persons have been of the opinion that the carrier plane never could be more than a second-rate craft as a result of its weight disadvantage.

Results of the Navy's three more recent strikes prove otherwise. In these operations our carrier planes provided the entire air power, challenging Japan's powerful island defenses. At Truk, on February 15 and 16, Naval aviators shot down 128 Japanese planes, destroyed eighty-two more on the ground, and sank twenty-two ships. That amazing victory cost us only seventeen planes. Three days later we struck the Marianas. Forty-eight of the enemy's planes were shot down in air combat, 87 destroyed on the ground, two ships were sunk and eight were damaged. Only six of our planes were lost. We lashed into the strong Jap base at Palau on March 30 and April 1, shooting down 117 planes. In addition, 39 planes were destroyed on the ground, 54 more probably destroyed, 14 ships were sunk, and nine others damaged. We lost 25 planes and 18 men.

The years spent by the Navy in tireless research in aerodynamics and aircraft structures are paying off in actual combat. The enemy is footing the bill in the form of blazing planes, sunken ships, and shattered bases. That price will be stepped up as additional carriers and planes join our fleets.

The enemy already has demonstrated that he can not meet the terrific cost. We are steadily pushing the Japanese back to their homeland, as they studiously avoid battle with our carrier striking forces. The Navy has been unable to bring a Japanese carrier to action since October of 1942.

"We are steadily pushing the Japanese back to their homeland, as they studiously avoid battle with our carrier striking forces."



Shown here is a part of the force that struck at the Marshalls. Nine carriers, a dozen battleships, and swarms of cruisers, destroyers, and supply ships are in this photograph—just a segment of the armada numbering in the multiple hundreds.

It was not until our first carrier strikes after Pearl Harbor that the Navy's designers and engineers were to learn whether the planes they had been constructing would stand up to the exacting tasks they were called upon to perform. No other aviation development had required greater efficiency and refinement in design than the ship-borne plane.

A delicate balance had to be struck between the plane and the ship, in order that both would have the highest possible performance. This meant special features in both the ship and the airplane. Space on ship board is at a premium. Every precious square foot of flight and hangar deck must be used to pack in the greatest air power. As for the airplane, space must be conserved in the takeoff run, space must be conserved in landing, and space must be conserved in the overall dimensions of the aircraft. Likewise, every consideration in the structure of the ship is necessary to afford the maximum space for airplane stowage as well as an optimum arrangement for the movement and servicing of the airplane complement.

To meet these requirements, penalties and limitations in the airplane's design became immediately apparent. The carrier plane, in order to take off in the shortest possible distance, would require relatively light wing loading; that is, a larger wing, the drag of which adversely affects high speed. It would need heavier landing gear to withstand the shock of hard, short landings on an unsteady deck. It would need an arresting hook, and structural strength to engage the ship's arresting gear. To conserve space, and thus increase the number of airplanes carried, it would need folding wings—hence the additional weight and mechanical complication of hinges.

All of these requirements tended to increase the airplane's weight and make difficult the attainment of high speed. They were requirements not imposed on land-base planes. But they had to be met if this weapon was to become an effective part of the fleet.

Research on these problems actually began November 14, 1910, when Eugene Ely, a Curtiss pilot, lifted his flimsy kite-like airplane from a 60-ft. platform built on the bow of the U. S. S. *Birmingham* at Hampton Roads, Va., to make the first successful takeoff from a ship. The Navy was mildly impressed with the possibilities of the airplane as a fleet weapon, but far from convinced.

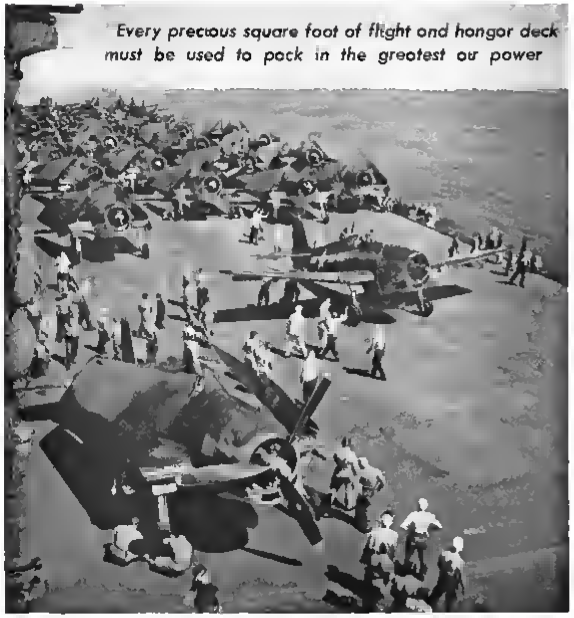
Never one to let enthusiasm lag, Glenn Curtiss arranged for a more impressive demonstration. A platform 120 ft. long was built on the stern of the U. S. S. *Pennsylvania*, anchored in San Francisco harbor. A crude arresting gear of lines attached to heavy sandbags was rigged up across the platform. A big hook was attached to the bottom of Ely's plane, in the hope that it would engage one of the lines before the plane went overboard. As evidence of his doubt, however, Ely wound a bicycle tube around his neck and shoulders as flotation gear. He took off from a field, landed on the *Pennsylvania*, and the gear functioned satisfactorily, drag-

Rear Admiral DeWitt C. Ramsey

"Many persons have been of the opinion that the carrier plane never could be more than a second rate craft. . . ."

Result of five days' carrier operation against Japanese island bases

Japanese plane losses	**555**
Japanese ships sunk	**38**
Japanese ships damaged	**17**
American plane losses	**48**



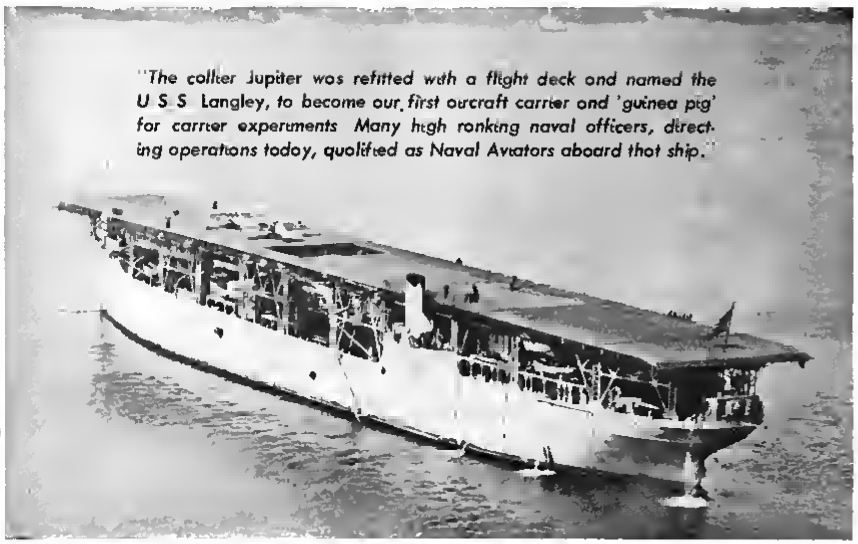
A Grumman Hellcat prepares for takeoff while Avengers and Douglas SBD's await their turn with engines warming up

ging the plane to a stop. He turned it around and took off again to land safely at his base. The flight proved to be the birth of the aircraft carrier and the carrier borne plane.

Much remained to be done, however, before the airplane was to win a place aboard ship. Space was, and still is, precious. The many problems appeared to be insurmountable.

The few short years before the first World War offered little time for conclusive experiments, although progress was comparatively rapid. The possibility of landing floats was tested in 1911 and found to be practical. The first successful catapult launching was made in 1912. Naval aviation had proved itself to the extent that planes accompanied the winter fleet maneuvers for the first time in 1913, under the command of Lieut. (now Vice Admiral) John H. Towers. Problems of scouting and locating "enemy" vessels, mine fields, and submarines were so successfully conducted that many officers who had been skeptical of the airplane's usefulness changed their opinions at that time. As a result, the following year, the first Naval Air Station was established at Pensacola, Florida. When war was declared in 1917 the Navy had one air station, 38 Naval aviators, 193 enlisted men assigned to aviation, and 54 airplanes. Most of the developments, however, had been chiefly in the line of flying boats.

It was not until the following decade that the real possibilities of carrier warfare were completely explored. The collier *Jupiter* was refitted with a flight deck and named the U. S. S. *Langley*, to become our first aircraft carrier and "guinea pig" for carrier experiments.

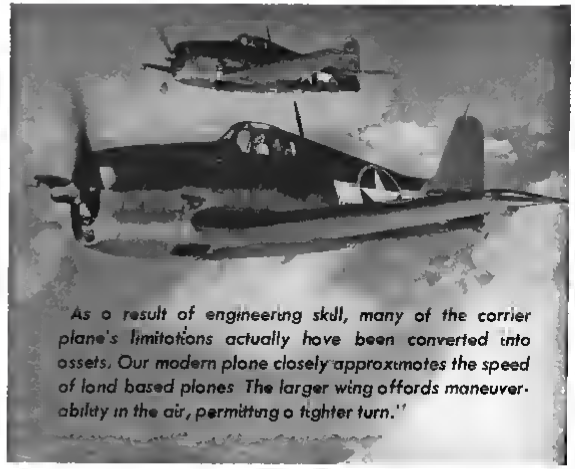


Many high ranking naval officers, directing operations today, qualified as Naval aviators aboard that ship.

Basic lessons learned aboard the old *Langley* still are apparent today. However, there is little comparison between that pioneer carrier and our modern ships. The original arresting gear on the *Langley* was an elaborate pattern of wires, raised six inches off the flight deck by a series of fiddle bridges, and purchases reeved to support weights in towers. The length of a plane's runout was adjusted by increasing or decreasing the number of steel weight plates. The pull exerted on the wires by landing planes was overcome by the weights. To prevent the planes from swerving over the side of the ship several hooks were attached to their fixed landing gears. These engaged fore and aft wires, string nine inches apart the entire length of the deck. The arrangement was cumbersome and required constant adjusting. Tire blowouts and damage to incoming planes were frequent.

The gear was improved as a result of experience and research, and by 1929 the fore and aft wires were removed. The next major improvement was the Mark 2 arresting gear, which supplanted the cumbersome system of weights. The new

(*Turn to page* 271)



Shown here is the Grumman Hellcat, newest of Navy fighters and one of the most perfectly engineered fighting craft in the world

AN AMERICAN AIR POWER POLICY

• *The attendance of the full Board of Governors of the Aeronautical Chamber of Commerce of America at the Los Angeles meeting, and the unanimous vote of the board with respect to chamber policy, is a hopeful augury for the future of the American aircraft industry.*

No industry faces greater difficulties with contract termination, disposal of surplus war goods and disposal of surplus plants. Our difficulties are at least directly proportional to our rate of expansion. Both our public and corporate responsibilities call for united effort along these lines, and we now seem on the way to get just this.

EUGENE E. WILSON,
Chairman, Board of Governors
Aeronautical Chamber of Commerce of America

LET US QUICKLY REVIEW the past as the first step toward an estimate of the future. No matter how well known the record may be to some of us, it is worth while to restate it here.

We recall that upon the outbreak of World War I the United States was wholly unprepared. This was particularly true in aviation, for whereas Europeans had looked upon the airplane as an instrument of war, we Americans saw it as a new vehicle of peace. Thus, we entered the war with no military airplane designs and no military engines of our own. We sought to overcome this disadvantage by adapting foreign designs to automotive mass production, and belatedly trying to create new ones of our own. And though a valiant effort was made, the brief 19 months of our participation was not enough to bring American designed aircraft into combat.

The sudden unexpected armistice of November 11, 1918, found us as unprepared for peace as April 17, 1917, had found us unprepared for war. We had neither adequate policy, program or organization for terminating war contracts or for the custody, storage or disposal of surplus goods or plants. As a result, there was vacillation, confusion and hardship. "War profits" proved illusory. Companies without adequate reserves or surplus failed. Automotive companies went back to automobiles. What little remained of the aircraft industry floundered in the doldrums. Some even thought the Army and Navy should design and build their own aircraft.

The Army, the Navy and the Congress took some cognizance of this situation. A number of Committees and Boards made recommendations. But nothing came of them. Then in 1925, in response to outspoken charges by Brig. Gen. William E. Mitchell, and to an aroused public opinion, President Coolidge appointed the "Morrow Board."

This board was requested by the Secretaries of War and Navy. These requests were in turn the result of representations by the Aircraft Industry whose importance to the Army and Navy was pointed out.

The Morrow Board consisted of nine members appointed by the President of the United States. Their number included a retired general, a retired admiral, two outstanding engineers qualified in aeronautics, a member of the Senate Committee on Military Affairs, a member of the House Committee on Naval Affairs (the Hon. Carl Vinson), the Chairman of the House Committee on Interstate and foreign Commerce, a judge of the Circuit Court of Appeals, and a prominent lawyer and banker, Dwight Morrow.

The board was non-partisan and non-political, and no member was directly interested in commercial or military aviation. The character and integrity of its members was such as to assure public confidence in their findings.

It heard nearly one hundred witnesses and many conflicting opinions. At that time, the state of the aeronautical art was such that little could be drawn from experience, yet the public had strong confidence in the future of aviation. After a short but active inquiry, the board submitted a unanimous report.

Against the background of charge and countercharge incident to the Mitchell controversy, the board's findings were unexciting. Yet they were so sound in principle that the report (now out of print), deserves reading and re-reading today even by those familiar with it. Congress accepted its recommendations and embodied them in the Air Corps Act of 1926. It created the office of Assistant Secretary for Air in the Departments of War, Navy and Commerce.

The board held, in effect, that a strong air force is vital to national security; that the backbone of this air force must be a strong, private industry, and that a long term, continuing program of procurement is essential to the creation of adequate engineering staffs and the acceleration of the new technology. Thus the board fixed responsibility for American airpower jointly upon government and private industry.

We take pride in the fact that the aircraft industry has fully discharged its responsibilities, even though at times the people's desire for peace caused them to falter in support of the Morrow Board policy. Whereas, in World War I, we borrowed aircraft from our Allies, in World War II, we supplied them.

The board realized the vital strategic importance of advanced engineering. It recognized the handicaps inherent in government design and appreciated the need of private competition for the development of creative design staffs. It also stressed the impracticability of maintaining a peacetime industry adequate to the requirements of war. It emphasized the need for rapid expansion in emergency and visualized it taking place around a small but potent aircraft industry. This forced aircraft designers to conceive an entirely new theory of quantity production, one that relieved it of the need for freezing designs and permitted it to expand phenomenally while introducing new and better models.

As contemplated by the Morrow Board,

(*Turn to page 279*)

A Recommendation for an American Air Power Policy

The Board of Governors of the Aeronautical Chamber of Commerce of America, in order to "provide for the common defense, promote the general welfare and secure the blessings of Liberty to ourselves and our posterity", and in order to insure that the airplane which America created shall be used to maintain peace and secure the blessings of peace to mankind, do unanimously recommend the early formulation of an American Air Power Policy under the following guiding principles:

The United States should maintain on *Air Power* sufficient (in conjunction with other forces) not only to win this war, but also, to keep the peace:

I. By maintaining adequate *Air Forces* at such strength and in such state of readiness as to preclude a successful assault upon our country or its possessions.

II. By acquiring and maintaining *Air Bases* essential to our security and that of overseas trade.

III. By facilitating the orderly and economic expansion of domestic and international *Air Transport* and of private flying.

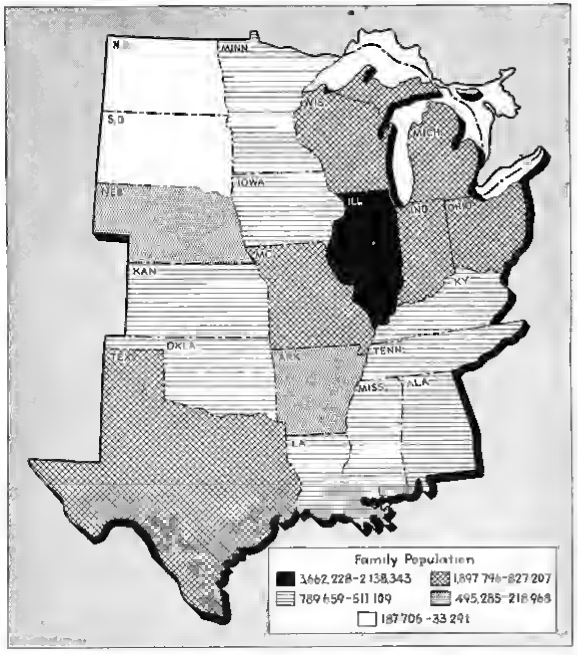
IV. By preserving a strong *Aircraft Manufacturing Industry.*

HERE ARE YOUR MARKETS

PART II—EAST AND WEST NORTH CENTRAL, EAST AND WEST SOUTH CENTRAL REGIONS

By JOHN FOSTER, JR., *Associate Editor, "Aviation"*

Second of "Aviation's" outstanding regional range-finding series detailing basic data for merchandising aircraft and aircraft parts . . . Covered this month are all pertinent market criteria for the middle United States



Mid-portion of United States embracing five East North Central, four East South Central, seven West North Central, and four West South Central states, covers five ranges of family populations ranging from 152 043 in North Dakota to 2 192 730 in Illinois. West North Central states have greatest variety, covering three of five ranges

BY ALL MEASURABLE marketing standards, the five East North Central states of Ohio, Indiana, Illinois, Michigan, and Wisconsin should become well populated with distributors and dealers of aircraft and aircraft parts and accessories. Good livings for these distributors and dealers, as well as profitable outlets for manufacturers, should be found there—for these states show up consistently strong when evaluated against market criteria as is revealed in our accompanying Table IV.

Ohio's 1,897,796 families, for example, own 1,599 678 passenger automobiles—or 84 per hundred families better even than the "hot" markets of New York. The Ohio families, 5 4 percent of the national total, have 6.28 percent of the buying income and make nearly 6 percent of the nation's retail sales possible.

The Buckeyes' acceptance of aviation is indicated by the fact that the state had, on Oct. 1, 1941 (the last available listing) 4 246 non-airline pilots and 1 318 registered aircraft (5.6 percent of all private planes in the country), leading the other four states of the region in each category. In the number of airports—113—Ohio is second to only one other state in the region, but with 2 74 airports per 1 000 sq. mi., it again takes first place in that section of the country.

Evaluated on the basis of the measurable data of family population, buying income, retail sales, automobile ownership, aircraft and pilot registrations, and airport facilities, Ohio stacks up as a Class A aviation market, ranking as the fifth strongest among the 48 states.

Neighboring Indiana, while geographically nearly as large as Ohio, has just about half the family population, 961 498, or 2 5 percent of the national total. Here again, though, the percentages of buying income and retail sales are higher, standing at 2 64 and 2.65 percent, respectively. The ratio of automobile ownership continues high in the Hoosier state too, for the total stands at 830 009, or 86 per hundred families.

Of the nation's 90 603 non-airline pilots registered on Oct. 1, 1941, 2 019 were listed in Indiana, and 643 of a total of 23 496 non-airline planes were registered there. As for flight facilities, a total of 57 airports means the state has 1 62 ports per 1 000 sq. mi. Combining the various factors, we find Indiana has an aviation market rating of Class B, standing in eleventh place in an individual state basis.

Illinois, bolstered by the largest population in the East North Central region, shapes up as a Class A market, its weighted rating putting it in fourth place among the states. Its family population of 2,192 730 measures out to 6 2 percent of the national total, a population with 6.74 percent of the national buying income, accounting for 6 29 percent of the retail sales. Automobile ownership ratio drops below that of the other states, totaling 1,699 596, or 78 per hundred families. Despite the greater family population, Illinois' aircraft and pilot registrations are just under Ohio's, standing at 1 299 and 4,133. And despite a greater land area, it has fewer airports—a total of 74, or 1 32 per 1,000 sq. mi., the majority of which are to be found in the eastern and northern parts of the state.

Michigan's passenger auto registrations of 1 399,795, just a shade over one for each of the 1,396 014 families, must be carefully weighed, since Detroit was, and no doubt will be again, the very heart of the automobile manufacturing industry. The Wolverines have, however, consistently good ratings in other criteria, for as compared with 3 8 percent of the family population, the state has 4 73 percent of the buying income and does 4 63 percent of the retail sales of the country. Its 945 aircraft figure out to an even 4 percent of registrations, and the 3 333 pilot registrations compare favorably with other states. Michigan's 133 airports give it 2 33 per 1,000 sq. mi., second only to Ohio among the East North Central states, a factor which helps give the state a Class A market rating. On a weighted basis, Michigan is rated as seventh most important of the 48 states.

Population-wise, Wisconsin is smallest of the five states, for its 827 207 families are 2.3 percent of the nation's. These families have 2 43 percent of the national buying income, and use it to make 2 44 percent of the retail sales. The 453 aircraft registered is the smallest total in the region, as is the total of 1 429 non-airline pilots. Likewise, the 52 airports comprise the lowest number, and the fact that there are but 95 per 1,000 sq. mi. tends to give the Badger state a Class B market rating, putting it at 13th place in the individual state listings.

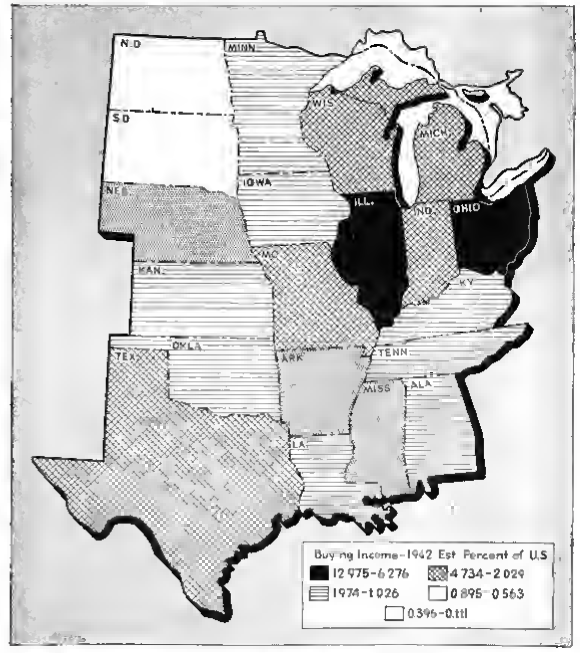
Consistency of the East North Central states' ratings combine to make them the second most important region in the country. This is clearly shown by the regional totals summing to a family population of 7,275,245, or 20 2 percent of the national total, with 22 82 percent of the buying income and 22 percent of the retail sales. Automobile ownership of 86 passenger cars per hundred families is exceeded only by the Pacific region.

Generally speaking, terrain would appear to have little effect on selection of distribution locations, but weather, particularly in northern Michigan and Wisconsin, would undoubtedly be a prominent factor, especially on the basis of today's personal aircraft utility. For at least part of the year, however, both these states offer unusual possibilities for widespread use of waterbased craft, a factor which should always be borne in mind in any consideration of distributor or dealer locations.

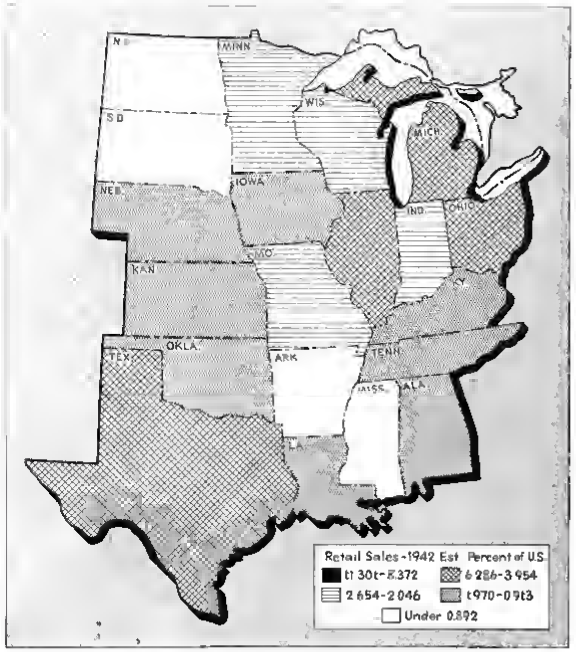
The East North Central region has always been known as good airplane country for private flying developed early and held to a high level in these states. This past aviation acceptance is evidenced by the fact that the total of 15,160 non-airline pilots exceeds that of the No. 1 Middle Atlantic marketing region and the registration of 4,658 planes runs a close second.

Table IV—East North Central Region

	Ohio	Indiana	Illinois	Michigan	Wisconsin	Total
1. Family pop.	† 897 796	961 498	2 192 730	† 396 014	827 207	7 275 245
2. Percent Nat'l pop.	5 4	2 3	6 2	3 8	2 3	20 2
3. Percent U. S. buying income	6 28	2 64	6 74	4 73	2 43	22 82
4. Percent U. S. retail sales	5 99	2 65	6 29	4 63	2 44	22
5. No. passenger cars	† 599 678	830 009	† 699 596	† 399 795	691 340	6 220 358
6. No. cars per 100 families	84	86	78	100	84	86
7. No. aircraft registered	1 318	643	1 299	945	453	4 658
8. Percent aircraft registered	5 6	2 7	5 6	4 0	2 0	19 9
9. No. pilots registered	4 246	2 019	4 133	3 333	1 429	15 160
10. No. airports	113	57	74	133	52	429
11. Airports per 1 000 sq. mi.	2 74	1 62	1 32	2 33	95	
12. Percent airports	3 8	1 9	2 5	4 6	1 8	14 6
13. State market rating	A	B	A	A	B	
14. Region market rating						2



Buying income percentages in four mid-U. S. marketing regions also cover five ranges, from .29 of national total in North Dakota to 6.28 in Ohio and 6.74 in Illinois. Note consistently high averages of East North Central region embracing Ohio, Indiana, Illinois, Michigan, and Wisconsin.



Again in retail sales percentages, 20 mid-America states show wide variety, covering four ranges, as compared with but two in both Middle and South Atlantic regions. It should be remembered, however, that many of these states are predominantly rural, where greater portion of needs can be produced by individual families.

This record would indicate that well planned and steadily pushed merchandising activities can make the East North Central region s consistently profitable aviation market.

East Soath Cantral

For mint juleps and horse races (the non-street car derby kind), Kentucky is the state of states, but for the distribution of aviation products, it has its peers

That's not the state's fault, it is simply a matter of geography and economics, two factors which have too often been overlooked in past attempts at aviation merchandising

The limited number of potential customers is clearly indicated in Table V, which shows the family population of 698 538 (19 percent) and 1 08 and 1 24 percent of the nation's buying income and retail sales, respectively. Further evidence is given by aviation acceptance criteria, for the 168 registered aircraft comprised hat 0 7 percent of those listed for the country, and the 547 non airline pilots make up the smallest total in the East South Central region This may be due in large part to the fact that the state has but 22 airports—0 55 per 1,000 sq mi. a contributing factor in the state's rating as a Class C market or 28th on a state-by-state rating

Tennessee provides a contrast especially noticeable in the number of pilots, for while it has 1,582 registered, its family population is not much higher standing at 714 894 or 2 percent of the nation's total Although this population is higher, the state's passenger auto ownership is low the figure being 323 926 against Kentucky's 349 116 By other marketing standards, the Volunteer state follows the pattern, with 1 25 percent of the buying income and 1.35 percent of the retail sales aircraft registration of 296 and 28 airports, all of which help establish Tennessee as a Class C market 24th most important among the 48 states.

Alabama is the third of the East South Central states to enter the Class C market bracket, and its weighted rating is 26th in the state listing This is based partially on the 673 815 family population 1 11 percent of the buying income and 1.31 percent of the retail sales and passenger car ownership of 251 202, or 37 per hundred families Aircraft registration is exactly the same as that in Kentucky—168—but the number of pilots is higher at 980 With 51 airports, or 1 per 1.000 sq mi., Alabama has more than the other three states in the region

Although it has a greater area than Kentucky and Tennessee, Mississippi has the smallest family population in the region—534,956, or 1 6 percent. Moreover, both buying income and retail are the smallest, standing at 56 and 63 percent, and the figure of 175 357 passenger cars is the lowest in the region The 145 aircraft registered follows the pattern of other three states but the 745 non-airline pilots give it third place in this respect, and the 47 airports give it second place in this category These factors combine to make Mississippi a Class D market ranking in 33rd place among the states

Combining the various data, we find that the East South Central region has a family population of 2,622,203, or 7 3 percent of the U S total, but that buying income is but 4 percent and retail sales stand at 4.53 percent. Despite the fact that the actual area covered is greater than in other regions the automobile ownership totals but 1 099 601 or less than that of some individual states The average of 42 per hundred families is lowest for any of the nine marketing regions The aircraft as registered numbered 777, or 3 4 percent of national total and the 3,854 non airline pilots have 148 airports available for use

Although the East South Central region measures out in last place compared with the other eight regions, there are several factors to be considered in setting up a distribution organization. Mississippi and Alabama both, for example, have had the benefits of other southern states in that the Army and Navy have concentrated their air arm training programs in this part of the country, this intangible "educational" stimulus may easily alter the course of future aviation behavior in that region, as will other factors which can best be evaluated in considering all the regions as a unit, as will naturally be done as a part of this series

Table V—East South Central Region

	Kentucky	Tennessee	Alabama	Mississippi	Total
1. Family pop	698 538	714 894	673 815	534 956	2 622 203
2. Percent nat'l pop	t 9	2 0	1 8	t 5	7 3
3 Percent U S buying income	1 08	1 25	1 11	56	4 0
4. Percent U S retail sales	t 24	t 35	t 3t	63	4 33
5. No passengers cars	349 116	323 926	251 202	175 357	1 099 601
6. No cars per 100 families	50	45	37	33	42
7 No aircraft registered	168	296	168	145	777
8 Percent aircraft registered	7	t 3	8	.6	3 4
9 No. pilots registered.	547	1 582	980	745	3 854
10 No airports	22	28	51	67	148
11 Airports per 1 000 sq mi	55	66	1 00	1 00	
t2 Percent airports	7	t 0	t 8	t 6	5 1
13. State market rating	C	C	C	D	
14 Region market rating					9

West North Central

The seven states of Minnesota, Iowa, Missouri, North and South Dakota, Nebraska, and Kansas, comprising the West North Central region give quite a cross section of market ratings—ranging from Class B to Class E and together making up the fifth most important of the nation's nine regions

That aircraft distributors and dealers as well as parts and service organizations can be successfully operated in this region is borne out by the measurable data compiled for this series, as shown in Table Vf, their locations can best be plotted when the region is considered in its relation position to the country as a whole

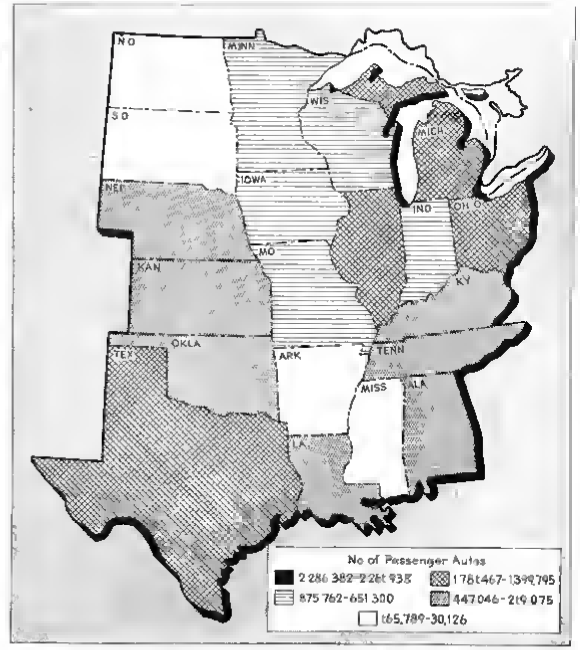
In analyzing the individual states, Minnesota has a Class B market rating, and stands at 14th place in the state ratings. This is based on its family population of 728,359, which is 1 9 percent of the national total Buying income amounts to 1 89 percent, but the state accounts for 2.05 percent of the country's retail sales Transportation requirements are indicated by ownership of 698,238 passenger cars, or 96 per hundred families a healthy ratio in any man's league

Minnesota had 1,928 non-airline pilots registered on Oct 1, 1941, according to the last available listing covering what can be called fairly normal times, and thus an average past acceptance of aviation is indicated. Its registration of 556 civilian planes, amounting to 2 4 percent of the national total, was second highest among the seven states of the region, and 46 airports—0 57 per 1,000 sq mi—is about average for the country. It should be remembered, however, that Minnesota has a better-than-average number of lakes from which to operate water-based or amphibious craft, especially as a seasonal proposition during the summer vacation period

Iowa, just below Minnesota on the map Is likewise just below it in aviation market ratings, the final tabulations putting it in Class B also, its weighted rating ranking it in 17th position among the states With 1.8 percent of the nation's family population, Iowa had 1 61 percent of the buying income and makes 1 77 percent of the retail sales. Its ownership of 651,300 passenger cars is at a ratio—93—slightly below that prevailing in Minnesota. A total of 1,896 non-airline pilots lived in the heart of the corn hog belt and among them they owned 511 planes, 2.2 percent of the national registrations Although Iowa has the same number of airports as Minnesota—46—the state's smaller area gives it .82 ports per 1,000 sq mi.

Missouri, a Class B aviation market and in tenth place on the state-by-state ratings measures out as the most promising in the West North Central region, for its family population of 1,068 642 comprises 3 1 percent of the U S total Two important percentages, however, are lower buying income standing at 2.40 and retail sales at 2.39, and its automobile ownership of 728,268 is at a ratio lower than all other states in the region A total of 2,789 non-airline pilots meant the state ranked seventh in the nation, and registration of 631 aircraft gave it tenth place on a nation-wide basis With 56 airports, Missouri flyers had 81 ports per 1,000 sq mi

Several factors, stemming largely from sparse population, combined to make both North and South Dakota Class E markets for aviation products, for they have but 0.5 and 0 6 percent of the nation's family population, respectively, but .29 and .30 percent of the buying income, and make .34 and .37 percent of the nation's retail



Note extremely close correlation between passenger automobile registrations shown here, and retail sales percentages by 20 states in four mid-U. S. marketing regions. Ranges for both criteria are exactly same for all states except Iowa, where automobile ownership rating is one class higher than for retail sales

Table VI—West North Central Region

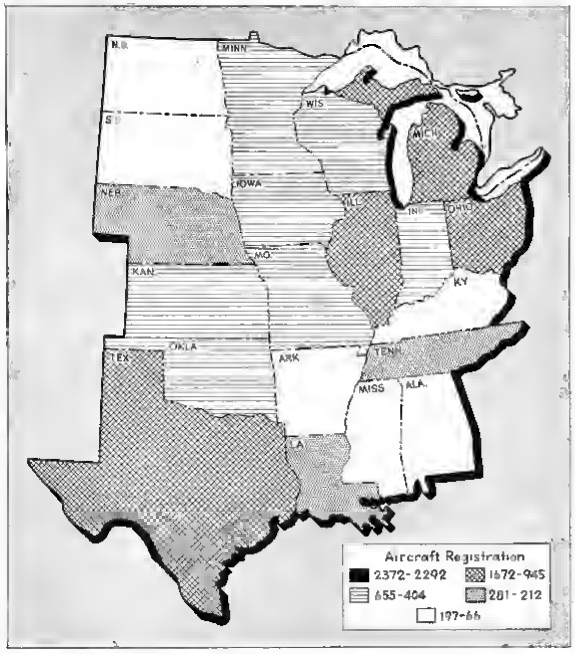
	Minnesota	Iowa	Missouri	North Dakota	South Dakota	Nebraska	Kansas	Total
1. Family pop	728 359	701 624	1,068 642	152 043	165 428	360,744	311 109	3 688 149
2. Percent Nat'l pop	1 9	1 8	3 1	5	6	t 12	1 6	10.7
3 Percent U S. buying income	1 89	1 81	2 40	29	30	80	t 42	8.39
4 Percent U S retail sales	2 05	t 77	2 39	.34	.37	91	1 22	9 06
5 No. passenger cars	698 238	651,300	728 268	t27,640	t48,163	327,658	463 648	3,144,915
6. No cars per 100 families	96	93	68	84	90	91	8t	85
7 No. aircraft registered	556	51t	83t	424	110	212	404	2, 638
8 Percent aircraft registered	2 4	2.2	2 6	.5	.5	9	2 1	11 2
9 No pilots registered	1 928	1 896	2 789	618	645	1,205	2,272	tt 353
10. No airports	46	46	58	23	24	6t	61	299
11 Airports per 1 000 sq mi.	57	.82	8t	.35	.32	.53	.74	
12. Percent airports	t 3	t.6	1 9	9	8	t 5	2 2	10.5
13 State market rating	E	E	E	E	E	D	C	
t4 Region market rating								8

sales This is not to say that airplanes can't be sold and serviced in the Dakotas, however, for in this territory the spaces start to become really wide open—increasing the utility of the airplane Transportation needs in the two states are clearly shown in automobile ownership, totaling 127 640 and 148 163, respectively a healthy number in comparison to population Aviation acceptance follows pretty closely to the norm with 618 non-airline pilots registered in North Dakota and 645 in South Dakota Respective aircraft registrations of 124 and 110 give each state approximately 0 5 percent of the nation's total, and 25 and 24 airports each give respectively 35 and 32 improved landing facilities per 1,000 sq mi On individual state ratings, South Dakota is in 41st place, and North Dakota in 43rd

Although Nebraska's largely - rural family population of 360,744 accounts for but .80 percent of the nation's buying income and makes .91 percent of the retail sales, it owns a total of 327,658 passenger cars, or 91 per hundred families, a good indication that transportation facilities hold a high place in family requirements Past acceptance of flying itself is shown by registration of 1 205 non-airline pilots, but the ratio of nearly 6 to 1 over the 212 aircraft owned within the state is nearly twice the national average of pilots-to-planes A total of 41 airports, or 53 per 1 000 sq mi are well distributed over the state, the generally flat character of the terrain should facilitate easy and inexpensive development of landing facilities On the basis of present measurable data, however, Nebraska is a Class D market, standing in 30th place as a state

Kansas is this region's only Class C market, and it ranks 20th among the 48 states Its registration of 2,272 non-airline pilots is third highest in the region, but ownership of 494 planes gives it fourth place, despite the fact that three major league manufacturers have long been located within the state and that its 61 airports are the highest number to be found in any one state in the region Non-aviation criteria are as follows Family population, 511,109, or 1 6 percent of the national total; buying income, 1.12 percent of the U S aggregate retail sales, 1 22 percent of the U S total, and passenger car ownership, 463,648, or 91 per hundred families

The seven West North Central states thus appear to comprise around 10 percent of the totals of the various criteria. The total family population of 3,688 149 is 10.7 percent of the national total; the buying income represents 8.39 percent of the total; retail sales come out at 9 6 percent and passenger car ownership of 3 144,915 is a little better than 10 percent Registrations of 2 638 aircraft amount to 11 2 percent, and the 11 353 registered pilots in the various states follow much the same ratio



On index of aircraft registrations East North Central region has two particularly good states—Ohio and Illinois. They have 1,318 and 1 259, respectively, putting them in fourth and sixth place among all states in this category. In West South Central region Texas registrations of 1,311 put it in fifth place on nationwide basis.

West South Central

In the West South Central region, two states—Texas and Oklahoma—have always been known as flyers' states; their people were quick to adopt the airplane both for pleasure and business With Arkansas and Louisiana, they make up the sixth most important marketing region in the country, as the data in Table VII shows.

As an individual state, Arkansas is in 34th place, measuring out as a Class D aviation market. Though they may not buy airplanes—only 190 were registered—Arkansans like to fly, for pilot registrations totaled 1,098. With 37 airports, or 71 per 1 000 sq mi, Arkansas has the lowest ratings in the region for these two categories

The 495 825 family population making up 1 4 percent of the American total have but 58 percent of the U S. buying income and account for 66 percent of the retail sales The total of 165 789 passenger cars owned is the lowest in the region, and the ratio is in the same place, for it stands at 33 per hundred families.

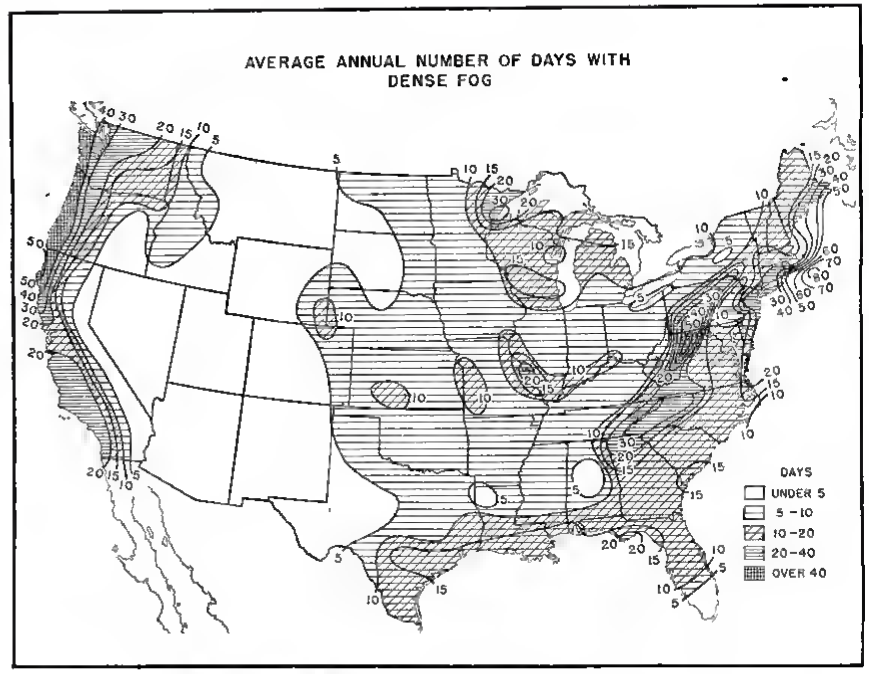
By comparison, Louisiana's 592,528 family population is 1 7 percent of the nation's with 1 23 percent of the buying income, 1 31 percent of the retail sales, and total passenger car ownership of 249,068 Louisiana's 1,331 non-airline pilots owned 267 planes, 1.2 percent of the national total, and the state has available 42 airports, an average of .81 ports per 1 000 sq mi Consideration of the state as a market should include the greater-than-average amount of usable water for amphibians or float planes On the basis of present data, though, the state tallies up as a Class C market, in 25th place.

Oklahoma's ambitious plans for becoming an air center may eventually change the state's rating and such developments should be watched carefully But on the basis of present measurable data, the state is in Class B its individual ranking being 19th among the 48 Family population of 610,481 is 0 1 percent greater than that in Louisiana, but the 1 03 percent of the buying income and 1 07 percent of U S. retail sales are both lower Automobile ownership, on the other hand, is considerably higher at a total of 420,194 or 69 for every hundred families In straight aviation criteria, Oklahoma's figures are all higher, for non-airline pilot registrations were recorded at 2,322 and aircraft registrations at 480, or an even 2 percent of those throughout the country Seventy-nine airports already in existence give the state 1 11 ports per 1,000 sq mi

Texas, having the highest figures in the region in all but one category—in most cases accounting for over half the totals chalked up by the West South Central states—has a Class A rating, for it is sixth in the state rankings The number of aircraft owned, for instance, is 1,311 or over 5½ percent of the nation's total, and here we have the highest ratio of planes owned to pilots registered, the latter figure standing at 5,912 Only category in which the Lone Star state takes second place is in airports per square miles— 85—even though the total of 225 is more than half of the region's total Owning a total of 1,172,617 passenger cars, Texas' family population of 1 678,396 is 4.8 percent of that of the country, and these families have 3 84 percent of the buying income and make possible 4.06 percent of the country's retail sales

Again in the West South Central region, figures closely approaching 10 percent of the national total show up frequently, the family population total of 3,377 230, for example, hitting 9 7 percent On buying income and retail sales, however, they drop some, standing at 6.68 and 7 09, and the total of 2,007,668 passenger car registrations is somewhat under 10 percent also The 2,248 planes owned amount to 9 7 percent, with 10,663 non-airline pilots standing at around 11 per cent and 383 airports making up 13 3 percent of the national total.

Aside from these measurable data, though, there are several less tangible factors to consider Texas, Oklahoma, and Louisiana have all seen a tremendous growth in military flying through headquartering of the Army Air Forces Training Command in Texas and concentration of flight training along the southern "good weather" belt of the country Natives of Texas and Oklahoma especially have been extensive automobile travelers; in the days before rubber and gasoline rationing, driving 100 mi. to a dance or favorite eating place—and back the same evening—was accepted as commonplace. The distances, too, are right down the airplane's alley, for as the weary Eastern motorist once said, "No matter where you're going, when you get to the middle of Texas you're halfway there"



As guide to weather conditions to be generally expected through United States, this government map shows distribution of dense fog (average annual number of days).

Table VII—West South Central Region

		Arkansas	Louisiana	Oklahoma	Texas	Total
1	Family pop.	495 825	592 528	616 481	1,678 396	3 377 230
2	Percent nat'l pop	1 4	1 7	1 8	4 8	9 7
3	Percent U S buying income	58	1 23	1 63	3 84	6 68
4	Percent U S retail sales	66	1 31	1 07	4 06	7 09
5	No. passenger cars	165 789	249 068	420 194	1 172 617	2 007 668
6	No cars per 100 families	33	42	69	70	59
7	No. aircraft registered	190	267	480	1 311	2 248
8	Percent aircraft registered	8	1 2	2 0	5 8	9 7
9	No. pilots registered	1 098	1 331	2 322	5 912	10 668
10	No. airports	37	42	79	225	383
11	Airports per 1,000 sq mi.	71	81	1 11	85	
12	Percent airports	1 3	1 5	2 8	7 7	13 3
13	State market rating	D	C	B	A	
14	Region market rating					6

THE ECONOMIC FUTURE OF AVIATION TECHNOLOGY

PART I

● RAPID TECHNOLOGICAL PROGRESS of recent years has opened vast new vistas of commercial opportunity. For the time being, technology is at war and is vastly stimulated by war needs. Its application to peacetime commerce, however, poses as complex a problem as its very development, and that problem must be solved if our technology is to have lasting value.

We all know that aviation has infinite peacetime application which will result in an improved economy. Inherently, aviation is power; is energy. Actually, it has yet to be harnessed to be geared to economy. How? When? Where? These are vital questions.

In this special series of studies, Mr. Flader casts some revealing light upon these perplexing problems. This initial article presents his discussion of the economy in which aviation will take its place. He asserts that aviation's capabilities as an economic force "depend entirely upon the ability of commercial airplane manufacturers to produce types which will operate at lower cost".

These articles will appraise the present and foreseeable types in this light. For the first time, therefore, we shall have an economy yardstick applied to jet propulsion, engine propeller combinations and combinations of both of these units.

This stimulating appraisal may well form the basis for future aircraft design and future commercial planning.

By FREDERIC FLADER
Consulting Aeronautical Engineer

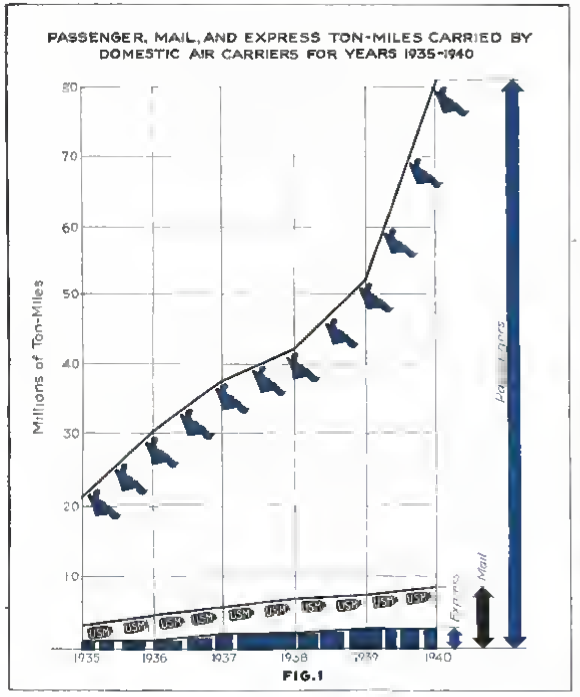


FIG. 1

IN THE MAINTENANCE of a livelihood and in providing a standard of prosperity above that of the minimum or subsistence level, there are only four factors of importance to people.

1. Natural products of the ground, sea, and air, such as food, minerals, forest products, and all other things which are given free by nature.

2. Labor expended by people to convert these natural resources into usable forms.

3. Transportation or location of these usable products in the places where they are needed.

4. Time—the fourth measure of real value.

Not'ng can be used to sustain life, nor can semi-necessities and luxuries be obtained, unless people expend energy or work to add one or more of the values of form, location, and time to natural products.

Air must be breathed into the lungs. A clear cold drink of water may be obtained from a spring but it must be lifted to the mouth and swallowed to be used. Food must at least be picked from a tree or dug out of the ground. To be of any value, things must be located where they are usable and at the time when needed. A lost battalion may need tanks and ammunition which have no value unless they are delivered where needed, and before the battle is lost.

All commodities must be provided with location and time utility. Usually this must be done by transportation on a schedule. The means of transportation must be determined from a consideration of the second measure of value, that is by that means which will locate the commodity where it is needed at the time when needed with the least cost in work or man hours. Time may be of great importance, in which case an expenditure of man-hours above the minimum attainable may be justified.

Raw products and heavy materials go by the cheapest method because here the time element is usually that of continuous flow and delivery is being of little importance how long enroute. The airplane as a means of transportation has been of importance only because of its time value. There are limitations regarding the value of time saved. Mentzer and Nourse have shown that there is no need for greater speed than that provided by an airplane which could leave the West Coast at the close of a business day and arrive at the Atlantic seaboard at the start of the next business day. The airplane now must compete both in time and on the basis of least cost. From the point of view of time utility, the airplane has no competitor.

However, the time element for cargo shipment is least important, dependability, regularity, and cost are more important for the vast majority of shipments. In the matter of competition at least cost the airplane will become increasingly important. In the long list of commodities requiring transportation there are many which are marginal as to the means of transportation to be selected. With those in which time is not the dominant factor the airplane will become increasingly important as it is enabled to furnish transportation with diminishing total expenditure of man-hours.

The possibility of the airplane capturing another increment of the available passenger, mail, and cargo market and thereby offering a greater public service depends entirely upon the ability of the commercial airplane manufacturers to produce types which will operate at lower cost. This possibility will be examined on a factual basis, applying the improvements which lie within the realm of engineering possibility. The application of turbo-compressor type engines in combination with propellers will be surveyed. The specifications concerning the engines will be based on calculations according to the best available engineering knowledge.

The power, weight, and fuel consumption characteristics will be attainable according to the present state of the art but will in no sense be representative of any existing propulsive units. This is a necessary stipulation, since all existing or projected types of power plants are classified. Therefore reliance must be placed on theoretical analysis and design.

The Matter of Cost

Money is not an absolute means of measurement of value in the true economic sense. The basic need in order to improve standards of living is to produce more with less expenditure of human energy or man-hours. However money is so universally used in the calculation of costs and since it is the medium of exchange which determines profit or loss, further consideration of the problem of costs in these articles will be in dollar units, for domestic operations. It is believed, however, that man-hour equations will eventually be a more fundamental and reliable guide for use in connection with foreign and international markets, since they eliminate the troublesome factors of the fluctuation of money value and rates of exchange.

In normal peacetime commerce there is a tremendous number of passengers and quantity of mail and express being transported by rail, motor, and by air. An analysis of the trends show that the airplane has become a very important factor in the transportation of passengers, and the increase in passenger business is continuing at a rapid rate. Mail delivery by air is slowly on the increase, whereas express shipments are increasing only at a snail's pace.

The curves of our Fig. 1 show the increase in air travel and shipments of mail from 1935 to 1940 and indicate clearly that the rate of gain in express shipments is not at all in proportion to the spectacular increase in numbers of passengers.

The potential revenue passenger business on all railroads in the United States during peacetime is approximately 82 billion passenger miles or about 850 million ton-miles. In 1940 the airplane was serving about 10 percent of the passengers who desired to travel. Mail carried by air in 1939 was approximately 9.8 percent of the total available whereas the express shipments going by air was insignificant, about .008 percent.

Rapid increase in passenger travel by air apparently shows that safety is no longer a major consideration, since passenger lives are more precious than express packages. It appears that people fly to save time, but that people do not ship by air because cost is more important than time saving.

Fig. 2 shows in graphical form the rail express shipments out of New York City to 13 other large cities during the month of May 1939 in tons, together with the air cargo shipments in Apr. 1939 in pounds. This shows clearly that air cargo is minor in comparison with rail express and that airline companies must be enabled to offer service at lower cost in order to obtain more volume.

Fig. 3 shows the shipments made in 1940 by air, first class rail express, standard rail express, and less-than-carload freight. These are not the total of all shipments, since some 24 billion ton miles went by truck and about 1.2 billion ton-miles were sent by forwarders. Rail and LCL freight are believed to be most comparable to air cargo transport because

(Turn to page 277)

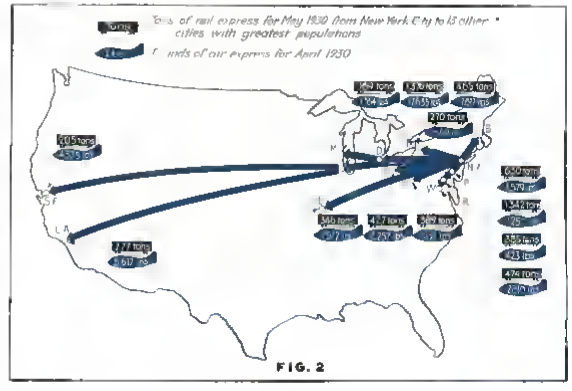


FIG. 2

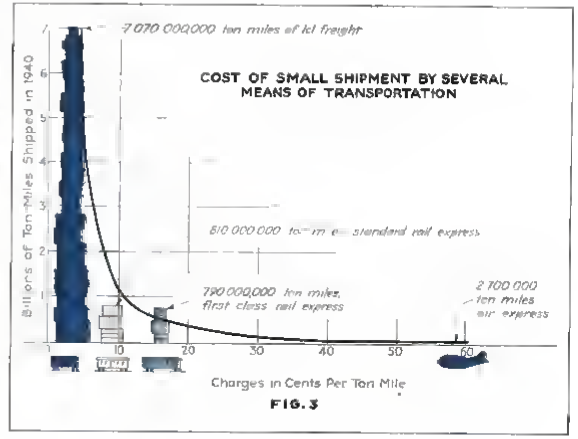


FIG. 3

DESIGN ANALYSIS NO. 6

DeHavilland "Mosquito"

PART II

By **CHESTER S. RICKER,** *Aviation's Detroit Editor*

Concluding his outstanding study, the author thoroughly details the landing gear, hydraulic and pneumatic systems, and controls of this remarkable twin-engine bomber.

HAVING DISCUSSED the airframe in detail, we shall now take up the design of the movable parts, such as controls, landing gear and hydraulic and pneumatic pressure systems. First, the controls—

Flaps

Trailing edge flaps are located between the inboard end of the aileron and the fuselage. The flaps are in two sections connected by a torque tube with hinges at each end and in the middle. They are constructed with spruce ribs reinforced with plywood. Finished flaps are covered with a 3-ply skin having the dual grain running longitudinally. The operating jack is attached to the rear spar and moves the flaps by a direct connection at center to the flap operating arm. Control reactions are taken by the rear wing spar almost immediately behind rib 3, where greatest resistance to deflection can be obtained. A rubber tube seal at bottom of the flap prevents any air leakage through the hinge during flight.

Ailerons

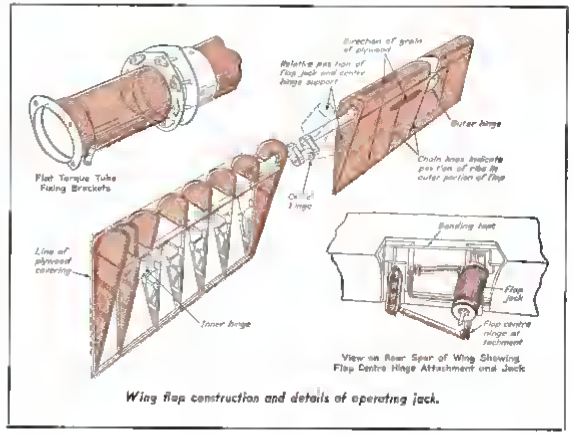
The aileron is built upon 24ST Alclad spar of channel section. The ribs, except those for hinges, are all of skeleton form and made from 24ST Alclad. The entire assembly is covered with 0.012 24ST Alclad skin. The tab, also made from Alcald, is attached at inner end of the aileron by means of a piano hinge. It is automatically operated by an adjustable linkage at the inboard hinge. Mass balances are provided in the leading edge of the aileron. It is supported by three hinges, the outer and inner ones of which are universal so that there can be no misalignment in assembly or in service. Tabs are differentially controlled, the port one being trimmed from the cockpit.

The empennage is quite conventional in general design, but the stabilizer and fin are of wood, while rudder, elevator and trim tabs are aluminum. This group also includes the tail fairings. No outside bracing is used, and all controls are easily reached after removing tail fairings, which are secured with Dzus locks.

Stabilizer

The stabilizer is one-piece all-wood cantilever construction of symmetrical airfoil section. It extends 110 in. each side of the centerline, is 16 in. wide at the tip and about 41 in. at the root. It is supported by two continuous wooden box type spars that run from tip to tip. Except for the center sections, these spars have spruce flanges top and bottom and 3-ply webs on each side. At center the spars are filled with laminated spruce at the point where the front one is attached to the fuselage and where the rear one carries the rigging brackets. There are ten spruce-and plywood ribs on each side of the stabilizer between spars. A similar number of spruce-and plywood formers are provided ahead of the front spar for the leading edge.

Small plywood brackets are provided on the back of the rear spar to support the skin where it overhangs. Each half of the stabilizer is covered with 0.16 in. 3-ply birch skins. The leading edge is made from a formed 3-ply spruce member into which the top and bottom skins are fastened and feathered off. Near the center on the forward side of the front spar there are three metal brackets which anchor the tail-plane to No. 7, or rear bulkhead of the fuselage. Two brackets bolted to front of the rear spar are connected to the rear bulkhead by two diagonal tubes at each point. These tubes have adjustable clevises at the rear spar



Wing flap construction and details of operating jack.

brackets so that incidence of the stabilizer can be adjusted when rigging the ship.

Construction of these stabilizer brackets is very interesting. Fittings attached to the rear bulkhead to support the front spar have screwed in bushings which may be adjusted about 1/16 in. in either direction. Thus it is easy to correct for slight variations in dimensions when assembling the stabilizer on the fuselage. To make an absolutely tight fit between fuselage bracket and front spar bracket which straddles it, a split bushing instead of a bolt is used. Each end of this bushing is bored out on a taper into which cones are inserted with a bolt so they can be drawn together to expand the split bushing. A castelated nut and cotter key secure the bolt when the bushing is tight.

At top and bottom of the rear fuselage bulkhead there are brackets to which the rear spar diagonal braces are attached. One through-bolt holds both in place. At rear spar brackets, the bracing tubes are attached with clevises, which have screw and lock nut adjustments to permit adjusting incidence of the stabilizer. This adjustment varies through angularity, so it is necessary to connect the clevises to the bracket proper through links pivoted on a horizontal pin. Thus no bending strains are introduced either in the tubes or on the threaded portion of the clevises.

What does not show in the drawings but is an important part of the support, are the longitudinal laminated spruce reinforcements which transfer loads from the rear spar brace brackets on No. 7 rear bulkhead to the fuselage floor and to No. 6 bulkhead. Metal angles backing up the brackets are fastened to these reinforcing members, thus the stabilizer forces are absorbed by both No. 7 and No. 6 bulkheads, as well as the monocoque structure enclosing them.

The stabilizer spars taper from center to tip, varying from about 7.25 in. maximum height at center to about 4 in. at the tip. In width they are also tapered from 2.25 in. at center to 1.25 in. at tip. The rear spar is straight, but the front has a sweep back on each side of about 1 in. in 4. The spar booms are formed from six laminations of 0.4 in. spruce and built up of selected long grain pieces. The front flanges are tied together with 0.16 in. 3-ply webs, the rear flanges by 0.12 in. 3-ply webs on each side. The inside of the spars is filled with 5-ply spruce blocks wherever a bracket is attached. The attachment points are armored on the outside with compressed 0.5 in. plywood. There are six of these points on the rear spar, two at the center, two at the ends, and two for the intermediate hinge brackets. At every rib point there are 0.5 in. wide and 0.4 in. thick vertical spruce stiffeners to which the leading edge, intermediate ribs, and trailing edge ribs are glued and screwed.

The stabilizer tip rib and the rib at the inside edge of each section have solid 3-ply sides that act as a closure. All the other rib units are of one-sided plywood construction. There are also two heavy box section ribs 1 in. wide and about 7 in. high near the brackets which support the stabilizer and act as compression spacing members between front and rear spars. They are bolted through metal angle plates to both spars and brackets and bear against compressed plywood facing on spars.

Elevators

The elevator is hinged to stabilizer rear spar by a center locating and four hinge brackets. The latter are of the universal type having a link with cross bolts that give each one considerable lateral freedom as well as providing the axis about which the elevator turns. Two similar self-aligning hinges are used for the rudder and mounted on the rear fin spar.

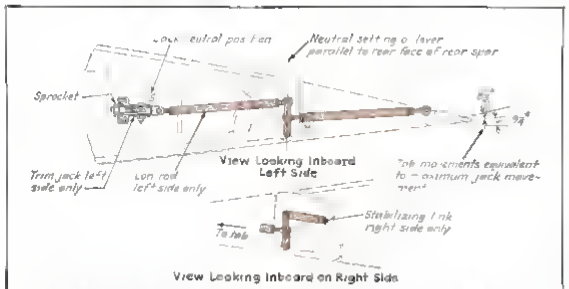
Each elevator is formed on a single box type Alclad spar. Elevators are interchangeable. Tab operating mechanism is under the elevator on the left side, and above the wing on the other, being covered with a detachable fairing. Alclad ribs are used in each elevator. Three ribs support the horn and six carry the tab. Second and third ribs from the inner end are closer together and straddle the tab operating rod. This prevents deflection at this point, assures uniform action in tab control, and provides secure anchorage for the elevator torque tube. Elevators are bolted together at the center hinge fitting.

To the port elevator torque tube flange are bolted the elevator operating arms, to which the operating cables are attached. These pass over ball bearing sheaves on the aft side of stabilizer front spar and through rear bulkhead into fuselage. To the starboard elevator a static balance weight arm is bolted. Mass balance weights are also provided inside the aerodynamic horn balance at outboard end of each elevator. The elevator torque tube extends through the two inboard ribs of each elevator and is riveted to them.

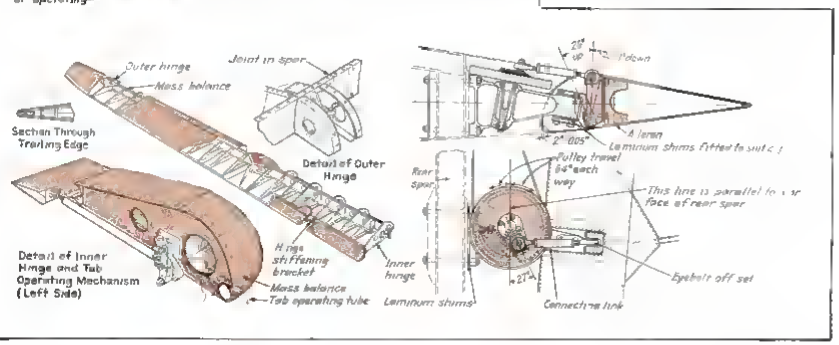
Elevator tabs are located between the inboard end of each elevator and the 6th rib from center. An Alclad channel spar connects the rear ends of these ribs and has a piano type tab hinge along its lower flange. The port tab can be used for trimming and can be adjusted 8½ deg. up to 9½ deg. down by the cockpit tab trim control. Adjustment is obtained by a screw trimming jack, located at elevator center bearing and bolted to back of the tailplane rear spar.

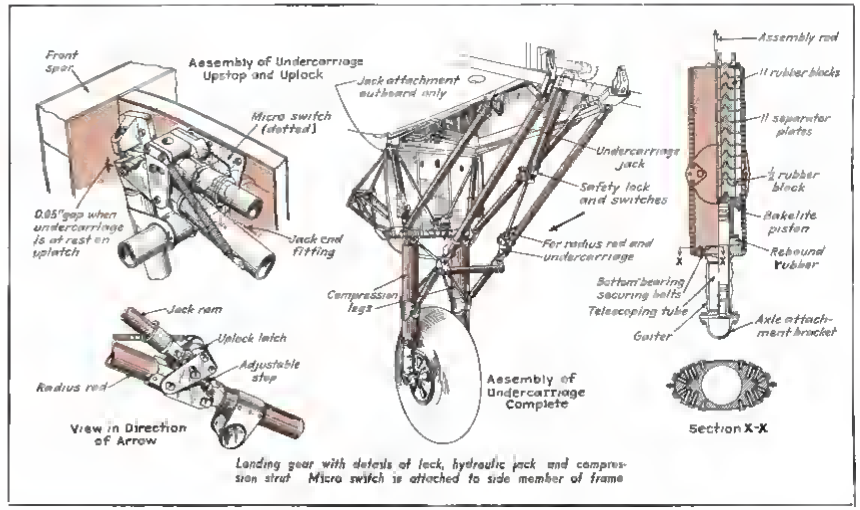
The trim control operates through a box-like member bolted to the left trim tab tube. A nut running on a vertical screw changes the tab position and is turned by a small chain sprocket at the top, which is controlled by a chain and two elevator trimming cables leading from the cockpit. Sprocket and cables are in a sheet aluminum housing to protect them from water or mud.

Elevator construction follows conventional practice. Forward edge has a 2.75 in. radius skin with a 5.12 x 0.75 in. channel main spar riveted inside, to which channel section ribs are attached. Aft inner corner of the elevator is braced by a diagonal tube. The ribs all have lightening holes and



Aileron showing method of construction with outer and inner universal hinges and center hinge on differential control bracket also trim tab controls and method of operating.



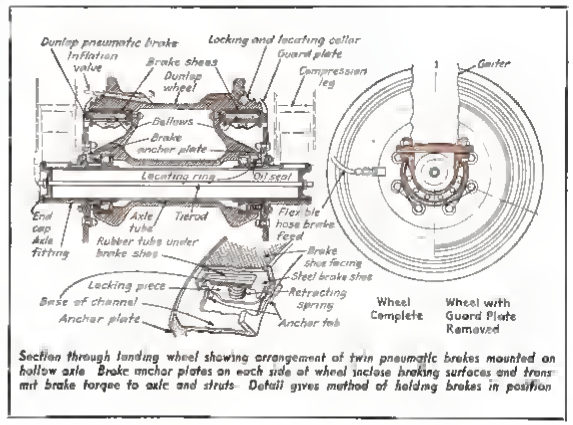


Landing gear with details of lock, hydraulic jack and compression strut. Micro switch is attached to side member of frame.

Landing Gear Data

Type—Two retractable single wheel units with two rubber shock absorber struts to a unit.

Wheel material (all wheels)	Magnesium
Wheel base	342.875 in.
Tread	196 D in.
Main gear compressor leg travel total	5.5 in.
Tail wheel	Swivel type, retractable
Main wheel dia.	16 in.
Tail wheel tire dia. (dual tread)	17.5 in.
Main wheel tire (Dunlop)	15.00 x 16 in.
Tail wheel tire	8.00 x 5 in.



Section through landing wheel showing arrangement of twin pneumatic brakes mounted on hollow axle. Brake anchor plates on each side of wheel inclose braking surfaces and transmit brake torque to axle and struts. Detail gives method of holding brakes in position.

'Z" section stiffeners are used top and bottom on the skins between ribs Trailing aml elevator tip edges are formed with an oval aluminum tube to which skins are fitted and riveted Brazier head rivets are used throughout The under skin and trailing edge are fastened by 0 12 m explosive rivets

Tail Fin

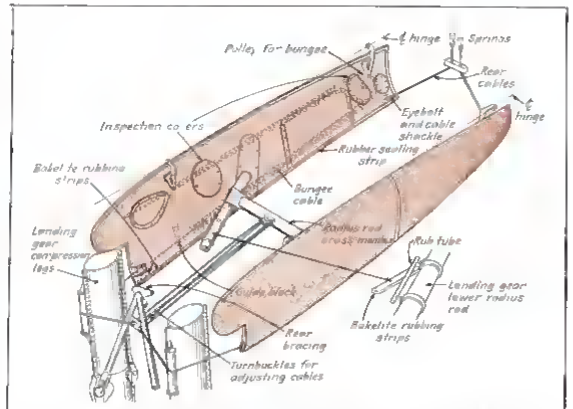
The single fin is attached to top of the fuselage by four brackets and four bolts These brackets are attached to the two rearmost fuselage bulkheads and project above the fuselage skin A fairing covers bolts and brackets after fin is installed. As will be noted, the fin and rudiler loads are well distrib uted over rear end of the monocoque structure

Fin spars are of heavy laminatel construction with 3-ply spruce webs The rear spar is approximately 7 in wide aml 2 5 in thick at the bottom, tapering to 0 87 in at top The front spar tapers from 2 12 to 1 in Front and back these spars have "H" shapcil laminated steel brackets bolted to the bottom ends The inner lamination runs about 13 in up the spar These metal brackets straddle the metal ones which strengthen the fuselage bulkhead extensions that project through top fuselage skin Brackets on the hottom of the two fin spars are 21 5 in apart on centers To give lateral stiffness to the fin bolt holes at rear bracket are spaced 2 87 in each side of centerline Two 0 75 in bolts are used to hold the rear spar two 0 62 in to secure front spar of the fin Lead ing edge of the fin is a 3 ply formed spruce member into which the skin is faired

The three rudder hinge brackets are holted to aft side of fin rear spar Where brackets are bolted Bakelite or compressed laminated wood is used as a bearing for both brackets aml bolts

Rudder

Rudder is a fabric covered metal structure while the tab is all Alclad attached by a piano hinge on the right side to metal rear spar of the rudder and extending upward from bottom edge of rudder to No 4 rib Tab is used to trim the rudder bnt also acts as a servo device It furnishes the trim and servo deflections to the left while a spring moves it to the right (this is fully explained under controls) Rudder is fastened to fin by three hinges along the rear spar Bottom hinge of the rudder and center hinge of the elevator are arranged to take both radial and end loads That is why all the other hinges can he universal



Bungee in wheel doors provides force for closing them when gear is raised Cable attached to radius rod cross member gives sufficient tension to bungee while rollers on outside of compression legs moves cable outwards to cause doors to open Bakelite rubbing strips on radius rods prevent wear on members

jointed Eleven hinges have ball bear ings and are packed in non-freezing grease

The rudiler is built like the elevator with an Alclad box spar consisting of the semi-circular hinge portion with a channel spar riveted between the open ends There are eleven metal ribs, three of which form the rudiler horn and carry the mass balance weight Five bottom ribs support rear spar and tab Tab mechanism is between ribs 2 aml 3 which are close together as on elevator Rudiler lower corner is braced by a diagonal tubular strut at tached to torque tube under rib 2 There is a diagonal tubular brace from rib 5 at the hinge spar to trailing edge The trailing edge is a flattened alumi num tube riveted between trailing edge flanges of the ribs The torque tube is bolted to ribs 1 and 2 of the rudder and carries tab operating tube inside it.

Landing Gear

Landing gear consists of two inter changeable units attached by tubular structures to the wing immediately be hind the engines Two brackets on front of forward wing spar serve as pick up points for both engine mount ing and undercarriage These brackets are bolted to companion angles that tie the front spar and wing ribs 3 and 4 together Landing gear supports ex tend downward behind firewall to a horizontal tube that serves as a hinge point for landing gear This upper structure is braced laterally by di agonal tubes and longitudinally by heavy tubes which terminate in brakets on the rear portion of wing ribs 3 and 4 forming fixed portion of the support

Movable parts of landing gear con sist of oval steel-tube compression struts hinged on fixed horizontal tube At bottom they are secured to the axle with forged steel "U" straps Legs are cross-braced by tubular members diagonally arranged and are held in place by radius rods that are attached to rear of legs and to rear wing spar A double acting hydraulic jack raises or lowers the gear.

Each landing gear unit is provided with doors that close automatically as the unit is retracted into the wheel bay A latch mechanism on the right hand radius rod holds gear in up posi tion. Down position is secured by a spring-loaded mechanical safety latch incorporated in the lower fitting on hydraulic jack cylinder It engages in a collar on the jack ram and is released only by hydraulic pressure on the safety valve when raising undercar riage.

Bottom sections of the right and left-hand hinged radius rods are joined together at their upper ends by a large tube aml forged fittings Since the hydraulic jack in only attached to the right hand radius rod, the cross tube must carry load due to lifting the left hand radius rod

A visual indicator in the cockpit shows when undercarriage and tail wheel are locked in up or down posi tion, and a warning horn will sound when landing gear is not locked down and throttles are more than three-quarters closed.

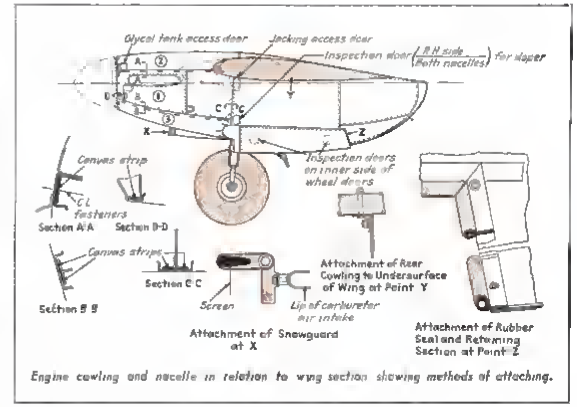
Two micro switches on the landing gear operate visual indicators, the up switch is just above the up latch bracket on right wing rib and operates when latch has engaged the uplock— the down switch is on the undercar riage jack cylinder A Gravmer gravity type is used. A second switch is introdnced in the circuit so that the gravity switch can be rendered operative when the wheels are down and inoperative when they are up This is necessary to prevent the fire extin guisher from functioning during aerobatics

Shock Absorber Strut

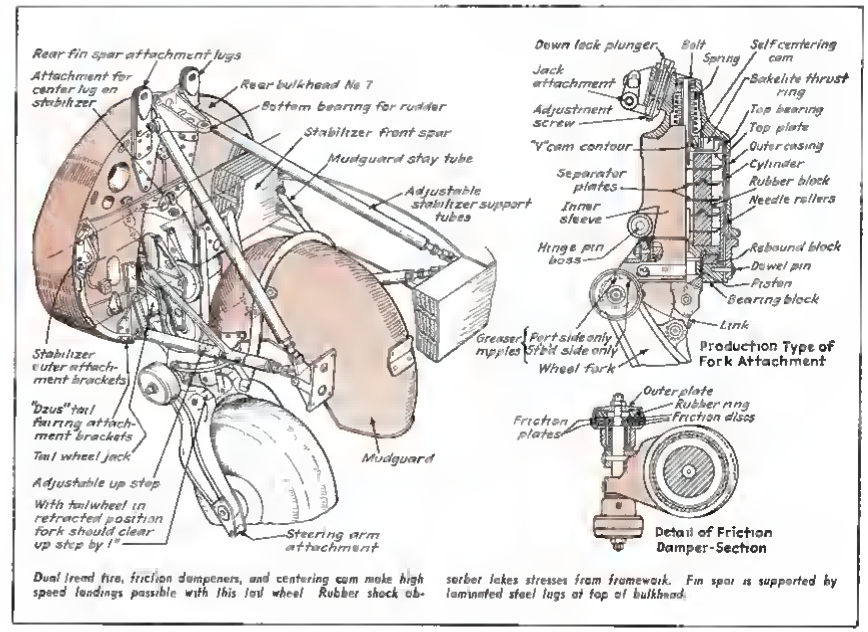
Two shock absorber struts are com pression rubber type and are oval in section, made from 8 ga. steel stamp lings The upper head carries a bracket that is hinged to the stationary landing gear frame. The lower or open end of the tube is closed by a fabric and Bake lite molded head which guides the tubular piston rod An oval Bakelite piston slides up and down inside the tube

Between head of strut tube and pis ton are nested eleven rubber compres sion blocks separated by aluminum guide plates The blocks are smaller in section than the tube to allow for ex pansion There are eleven blocks of full thickness and one of half thickness all located above the piston and also one block beneath the piston to absorb rebound Each block is molded with two conical projections on top and corresponding depressions in the bot tom to keep blocks and plates in align ment The piston tube is attached to the Bakelite piston by screws and threaded rods Where the piston rod passes through the Bakelite guide, the bore is lubricated with graphite. Bottom end of the piston tube carries a rectangular forged flange to which the wheel axle is attached by a forged steel U-shaped strap and four bolts

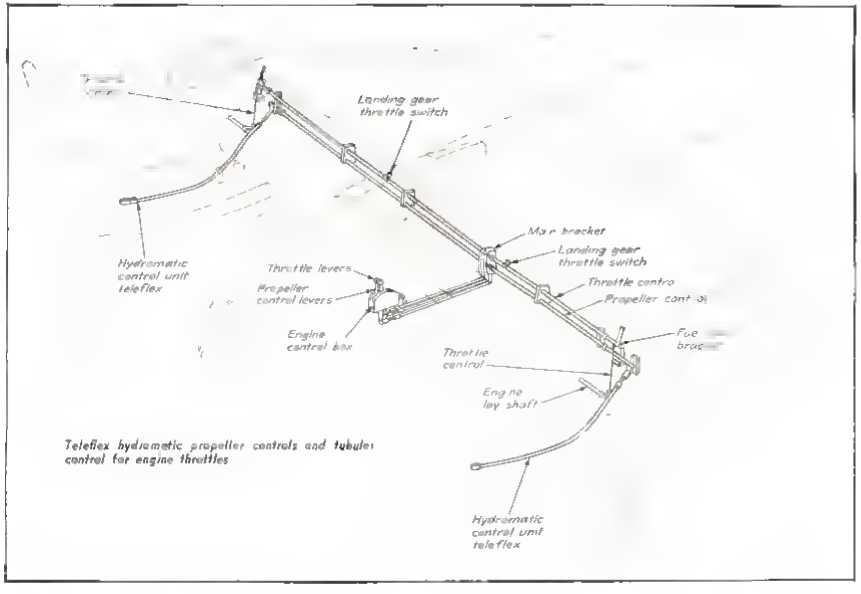
Since there is no hydraulic or pneumatic mechanism in the strut to



Engine cowling and nacelle in relation to wing section showing methods of attaching.



Dual tread tire, friction dampeners, and centering cam make high speed landings possible with this tail wheel Rubber shock absorber takes stresses from framework. Fin spar is supported by laminated steel lugs at top of bulkhead.



Teleflex hydromatic propeller controls and tubular control for engine throttles

leak, it can be made without recourse to micro finishes. No adjustment is required in service beyond renewal of compression and rebound rubbers after considerable service. For small adjustments a full block of rubber can be substituted for the one of half thickness.

The tube is made from two stampings of 8-ga. steel that are held to very close limits. They are riveted together in pairs to form a complete oval tube and do not require further finish inside after assembly.

Exposed end of the piston rod is fully protected from the elements, dirt, and water by a boot attached to bottom head of tube and axle attachment forging.

Landing Wheels

The landing wheel is a magnesium casting of Dunlop design, made by Kelsey Wheel, and mounts a 15.00x16 in. tire with anti-skid tread. The tire is held on the wheel by a flanged locating collar secured by a locking ring. Wheel is mounted on two anti-friction bearings supported by tubular axle. End caps and a tie rod retainer seal ends of axle tube. Axle end fittings carry ball bearings, are flanged to attach the brake anchor plates. The hub of these fittings has a flat upper surface with a spigot to lock and pilot the shock absorbed strut bottom. Through this the braking torque is transferred to the shock absorber unit.

Brakes

There are two 13 x 3.25 in. internal expanding brakes in each wheel. They are pneumatically operated by a rubber tube located just under the six brake shoes in each brake assembly. The brake anchor plate has a channel shaped rim which extends inward beneath the braking surface of the wheel. This channel is 3.37 in. wide and 0.5 in. deep. It has 1.5 in. slots at 60 deg. intervals, which are located at each side of the channel and go clear through to the inside. The rim of the channel is unbroken. These slots anchor the brake shoes. Each brake shoe is made from a 16-ga. steel channel 3.25 in. wide and 0.37 in. deep. At center of each flange there is a slotted tongue 1 in. deep and 1.5 in. wide to fit in the slots of the brake anchor plate.

In assembly, the rubber tube is first laid in the anchor plate channel, then the six brake shoes are slipped in place. To hold them, a retainer yoke goes across between slots in lower ends of the brake shoe anchor tongues. A small coil spring is slipped in between yoke and underside of the anchor plate. This not only locks the brake shoe in place but draws it down tightly against the anchor plate channel and prevents it dragging when brake is released. The individual brake shoes have a 3.25 x 0.25 in. brake lining riveted to their working face.

A regular tire tube angle stem is used to connect the air pressure line to the brake expanding tube. This is stationary, so after it passes through the brake anchor plate it can be connected directly to the air pressure tubes fixed to the side of the compression leg. A flexible air pressure hose joins tubes and fitting on the anchor plate so as to allow for shock absorber action of the compression leg.

Since the magnesium wheel does not of itself make a good braking surface, cadmium plated steel inserts, 0.18-in. thick, are provided. They have a 1 in. lip on the inside that is secured to the magnesium wheel with 16 0.312 in. bolts.

Spring closed L-shaped oil seals are provided at each end of the axle to prevent any grease working out of the hub and being thrown on the brakes.

Wheel Doors

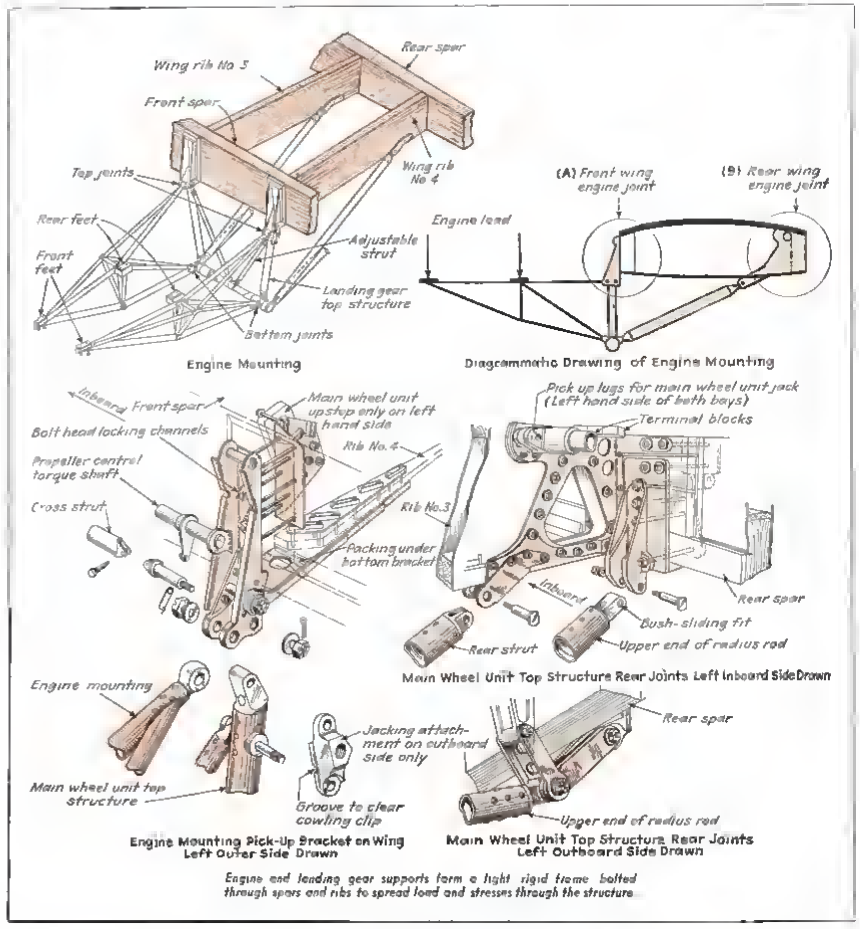
Wheel doors are contoured to enclose nacelle bottom from engine firewall back to rear spar. They are made from two sheet aluminum stampings riveted together along the edges, and there is a stiffening rib at the front hinge section. Each is supported by two invisible type hinge brackets. The lower edges have a 0.5 in. rubber tube to provide a seal. Front and rear ends fit over canvas sealing pads riveted to nacelle panels.

Operation of the doors is perhaps the most interesting feature of the assembly. The rear ends are drawn together by spring-loaded 0.18-in. flexible steel cables and are opened by tubular steel guards attached to the underarriage legs as landing wheel is lowered. After legs clear ends of the doors, tubes attached to sides of lower radius rods catch Bakelite rubbing strips on bottom edge of doors and keep them apart.

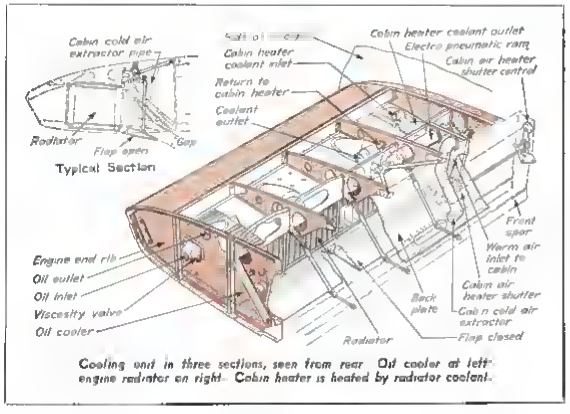
To pull the doors together, 0.18 in. flexible steel cables are used. These are attached through turnbuckle adjustments to the cross piece between diagonal leg cross braces. They are then led back to a pair of pulleys on the radius rod cross member tube and forward again through bronze fairleads in the cross piece to which the ends are first attached. From the fairleads the cables pass over long Bakelite rollers attached to front of the compression legs and thence into front end of the wheel doors guided between a couple of plastic sheaves.

End of the cable is attached by eye splices to the end of a ⅜ in. "bungee," which is led around a pulley at rear of each wheel door and back to the front end of that door. When doors are open, the "bungee" is stretched almost double its original length. Thus structure permits keeping the doors under tension at all times, whether open or closed.

The hydraulic system used for operating the landing gear contains two independent circuits—one the regular, the other an emergency system. Two hydraulic pumps are used, one on each engine. A hydraulic accumulator is provided in the aft part of the fuselage between bulkheads 3 and 4. Lines from



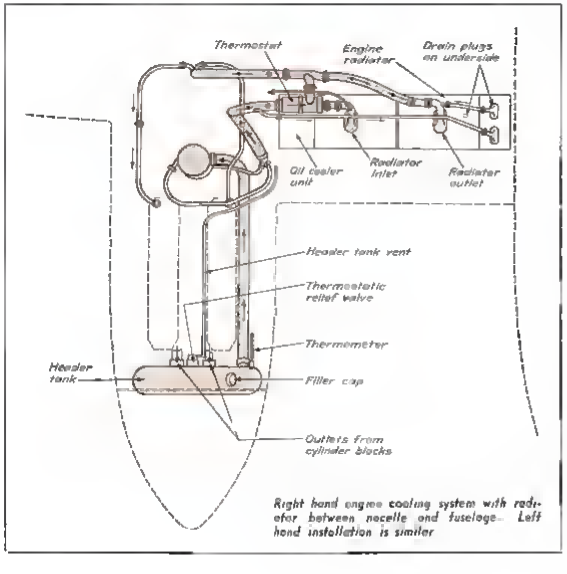
Engine and landing gear supports form a light rigid frame bolted through spars and ribs to spread load and stresses through the structure



Cooling unit in three sections, seen from rear. Oil cooler at left, engine radiator on right. Cabin heater is heated by radiator coolant.

engines to junction block in the cockpit, and from selector valve to undercarriage jacks, run along the front side of main wing rear spar. Hence if the front lines are damaged it is still possible to lower the wheels. A hand pump can be used for this purpose if engine pumps are not working. Emergency selector valve just behind pilot's seat cuts in emergency line. This line does not connect with the tail wheel, and the ship has to land without it being lowered, but the damage sustained would be minor compared with a "belly landing."

Undercarriage and tail wheel selector lever is center in the hydraulic control box in cockpit. A safety catch must be released before the up position can be selected. Selector lever should return automatically to neutral when up or down operation is completed. If it should return prematurely, it is put down again by hand. This is possible in cold weather due to the greater viscosity of the hydraulic fluid.



Right hand engine cooling system with radiator between nacelle and fuselage. Left hand installation is similar.

Tail Wheel Assembly

The 8.00 x 5 in. tail wheel is on a retractable unit having a vertical trunnion. Like the undercarriage legs it has rubber type shock absorber. The wheel is mounted on a hinged fork attached to a caster swivel. Load is transmitted from hinged fork to rubber elements in swivel cylinder by link and piston rod. Shock absorbing elements are carried in a steel cylinder on needle bearings inside the shock absorber casing on the rear fuselage bulkhead. The jack ram is connected to the casing through a link which retracts the locking pin before it starts to raise the tail wheel.

A micro switch operated through a flat spring, which contacts the tail wheel casing when it is in the down position, closes the circuit to the indicator on instrument panel. No indication is provided when the wheel is up.

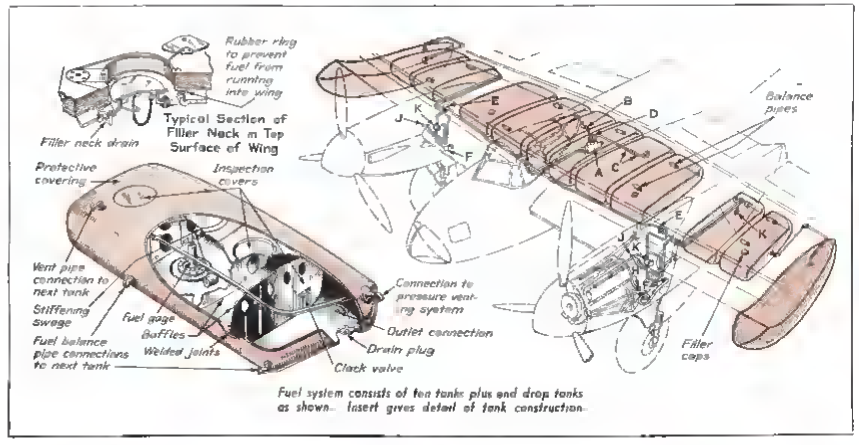
The shock absorbing unit has six rubber blocks for cushioning purposes and one between shock absorber piston and bearing block to take rebound.

The outer casing is a magnesium casting in which the shock absorber cylinder rotates. The cylinder is supported at the head end by a plain bearing and at the lower end by a needle roller bearing so there is no wear on the softer magnesium. The top plate or cylinder head bears against a Bakelite thrust ring when the shock absorber is in action. This top plate carries a V-shaped centering cam. Another cam that does not rotate is located in the head of the casing and spring pressed against the V-cam on the cylinder to center the tail wheel in flight. The cylinder is held in place by a hollow bolt through the center and supported by a ball thrust bearing.

The shock absorber piston is guided by a bearing block inserted at bottom end of the cylinder. The method of locking the fork attachment to it with dowel pins is interesting. These pins are held in place by a band with notched holes that slip into a grove under the head of each dowel pin.

Cylinder and inner sleeve are fastened to the fork attachment by countersunk bolts.

Adjustable friction disk vibration dampeners are applied to the hinge shaft of the fork attachment. A rubber compression ring is used to adjust their tension. Tail wheel assembly on the rear bulkhead is pivoted on two bearings located as far apart as possible



Fuel system consists of ten tanks plus end drop tanks as shown. Insert gives detail of tank construction.

and supported by a tube. This tube prevents their binding under severe twists. Laminum shims in the supporting bracket bushings permit axial adjustment of the tail wheel assembly so the locking pin will align with the locking ring in the rear bulkhead.

The combination of self centering cam friction shock absorbers and dual-tread tail wheel provides an unusually safe and satisfactory tail wheel action during high speed landings, according to the designers.

Engine Cowling

Engine cowling, nacelle, and wheel doors form a streamlined unit that is beautifully faired into the main wing when the ship is in flight. Dzus fasteners are used to hold the engine cowlings in place. All joints are made practically air tight, either with tubular rubber or canvas seals.

Engine Controls

Throttle and propellor controls are mechanically operated from the cockpit through levers and ball bearing torque tubes attached by brackets to the front wing spar. Cams on throttle torque tubes operate undercarriage warning lamps and horn switches when the throttles are more than three-quarters closed.

Two-speed supercharger on each machine is controlled by an electro-pneumatic ram. With cockpit switch set at *Auto* an aneroid operated switch will bring the supercharger into operation at 15,250 ft. altitude. If the switch is set at *Mod* (moderate) only single-speed supercharging will be obtained at all altitudes. Flexible cables from cockpit to engines cut out "slow running" and "automatic boost" controls when required in emergencies. Additional electro-pneumatic air intake controls are provided for tropical operation.

Mounting

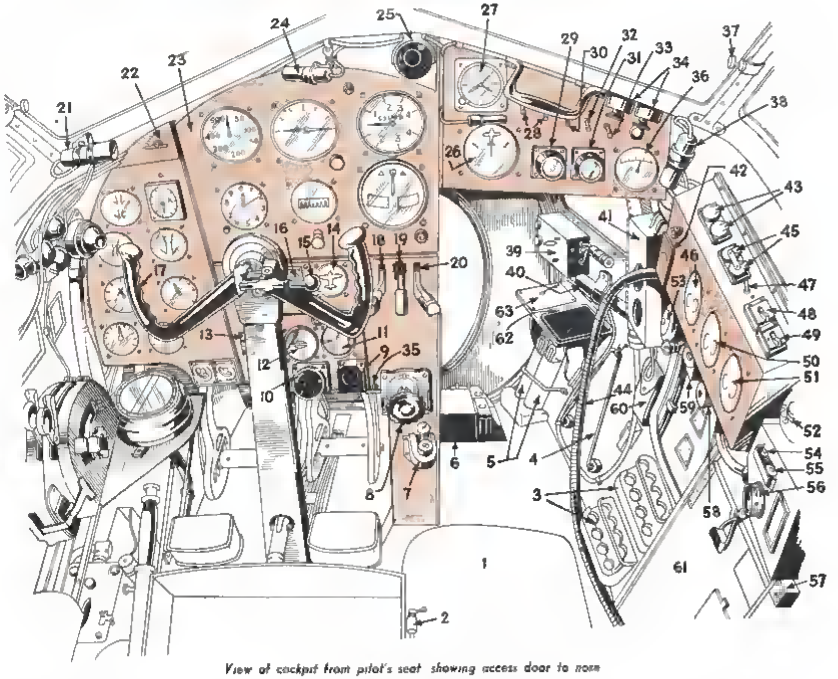
Two Packard-Rolls Royce *Merlin* 31, 33, or 225 engines are used. They are mounted on four feet cast integral with the crank case. To support the engines in the plane, a tubular steel frame is provided. This consists of two units, one left and the other right, which are attached to brackets bolted to the front of the front spar. Ribs 3 and 4, immediately behind these brackets, give them the necessary torsional rigidity. The interesting feature of this structure is combination of engine mounting frames with fixed undercarriage tubular members. This makes an inverted bridge truss that not only supports the engine but strengthens the landing gear. The construction transmits the engine inertia loads directly to the undercarriage when landing instead of through the wing structure.

To take engine torque and provide lateral stability for the engine, transverse and diagonal bracing is incorporated in each mount. Construction of the spar attachment brackets for undercarriage and engine are of unusual interest. Ordinarily it is quite a difficult problem to make transition from metal to wood, but the problem is handled in a very direct and simple manner in this case. Even the flap jack and center hinge support are tied into this structure to get maximum bracing.

Sixteen gallons of water and ethylene glycol mixture are used in each engine, with provision of an expansion header tank just ahead of the cylinders. Filler opening for the cooling system is to header tank. A thermometer is provided to indicate engine temperature on the instrument panel. Thermostats and movable radiator air duct flaps control engine temperature. The flaps are controlled by the pilot. The automatic thermostat valves are designed so only jacket coolant is circulated up to 185 deg. F. This provides a quick warm-up. Above 221 deg. F. all coolant circulates through the radiators. Each engine has its own cooling system for both coolant and lubricating oil. The connections are short and direct from engine to radiator core.

Radiator is located on front spar between fuselage and engine nacelle. The air duct forms leading edge at this point. Radiator unit cover forms the top of the wing, and the same is true of the bottom. The radiator cores are mounted in an aluminum frame structure that is bolted to the front of the main wing spar. The lower connections are tubular in form, provided with a screw adjustment for length. The top is attached to the wing spar by the five channel shaped ribs which go over the top of the radiator cores. These ribs have lightening holes through which the service pipes are threaded. Diagonal tubular braces at center steady the whole installation laterally. They also take reactions from the electro-pneumatic ram which operates the cooling flaps in the air outlet stream.

Air enters the radiator duct through



View of cockpit from pilot's seat showing access door to nose

1 Front entrance door
2 Harness release lever
3 Very light cartridges
4 Spare storage
5 Portable oxygen bottles
6 Searchlight box
7 Deicing hand pump
8 Aileron lateral trim control
9 Aileron trim indicator
10 Brake pressure gage
11 Oxygen contents gage
12 Oxygen flow indicator
13 Master switch
14 Flap and undercarriage indicator
15 Brake lever
16 Undercarriage position indicator
17 Handwheel
18 Bomb door control lever
19 Undercarriage and tail wheel control
20 Flap control lever
21 Lamp
22 Automatic hand pilot control
23 Blind flying instrument panel
24 Lamp
25 Ventilator
26 Visual indicator
27 Time of flight clock
28 Radiator flap switches
29 Feathering control switch—left
30 Navigation lamp switch
31 Feathering control switch—right
32 Fuel pump switch
33 Pilot head switch
34 Dimmer switches
35 Bomb jettison switch
36 Air temperature gage
37 Direct vision panel knob
38 Air observer's lamp
39 Spare bulb
40 Pitot and axe
41 Camera temperature indicator
42 Voltmeter
43 Fire extinguisher switches
44 Navigator's oxygen tube
45 Push switches
46 Fuel contents gage outer tanks
47 Switch
48 Navigation head lamp switch
49 Downward identification lamp switch
50 Fuel contents gage, centre tanks
51 Fuel contents gage inner tanks
52 Downward identification lamp switch
53 Oxygen demand regulator
54 Booster pump switches
55 Recognition light switch
56 Wolrh holder
57 Power socket
58 Oxygen contents gage
59 Oxygen flow indicator
60 Camera sliewage
61 Navigator's hinged table.
62 Elbow rest.
63 Writing tablet

a slot in the leading edge of the wing, but the flow is controlled by position of the outlet flap below and behind the radiator cores. A back plate streamlines the air beneath the front spar when the flap is open. Flaps for each engine are separately controlled by switches at the pilot's hand. The electro pneumatic rams are designed to close flaps when the temperature is below 230 deg F and open them when it reaches 239 deg maximum.

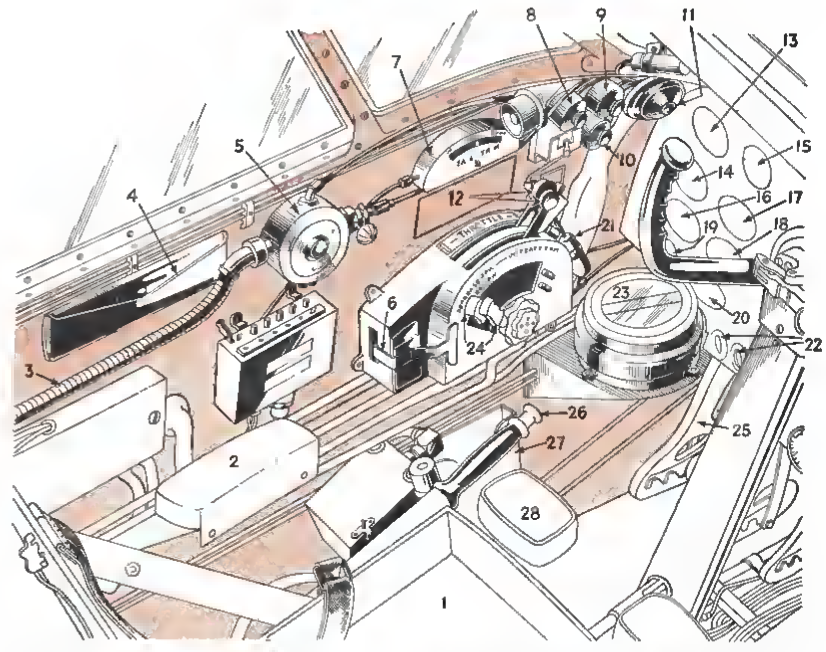
The radiator core is divided into three sections. A small section with a special outlet passage is located next to the fuselage. There is a hand-operated flap in this passage controlled by the pilot. When flap is closed, all air passing through this section of the radiator goes into the cabin through an inlet tube inside of the fuselage. An air tube from cabin to airstream is also provided to exhaust the air.

At the engine side of the radiator there is a honeycomb type cellular core to cool oil in the same airstream but entirely separate from the engine cooling section. The engine cooling radiator core is of the fin and flat tube type.

All oil and liquid couplings are made with the "Alvino" design. The thermostatic relief valve mounted on the header tank controls pressure in the cooling system and suppresses boiling. It also admits air to the header when temperature falls, thus relieving the system of sub-atmospheric internal pressures. A relief valve opens up at two atmospheres pressure. The vent tube discharges just aft of exhaust stacks.

Fuel System

Fuel is carried in five pairs of aluminum alloy tanks protected by self-



Left hand side of cockpit

1 Pilot's seat.
2 Pilot's arm rest.
3 Pilot's oxygen tube
4 Pilot's panel.
5 Oxygen demand regulator
6 Supercharger switch
7 Elevator trim tab indicator
8 Dimmer switch.
9 Dimmer switch
10 Compass dimmer switch.
11 Throttle controls.
12 Oil and fuel pressure gages
13 Steering indicator
14 Radiator temperature gage.
15 Manifold pressure gage, left
16 Oil temperature gage.
17 Manifold pressure gage, right.
18 Tachometer left
19 Tachometer, right.
20 Compass lamp
21 Landing lamp switches
22 Compass.
23 Propeller control lines
24 Rudder pedals.
25 Pilot's seat adjusting lever
26 Map case
27 Pilot's thigh rests.

sealing coverings. They are all housed within the main wing and have a total capacity of 674 U. S. gal. Electrically operated gages indicate contents of each pair of tanks. Filler openings are through top of wing or fuselage for all tanks. On the starboard side of the fuselage there is a fuel collection gallery casting that has disk-type non-return valves to prevent flow of fuel from one tank to another.

The outboard tanks feed direct to their respective engines, through the main control cocks and through the booster pumps, but they are not connected to the fuel gallery with the other tanks. The fuel gallery feeds both engines from the tanks connected to it. Each pair of tanks is provided with a drain cock and all delivery connections have a check valve so they can be disconnected without loss of fuel. Pressure is applied to tanks, but it can be cut off and the tank vented.

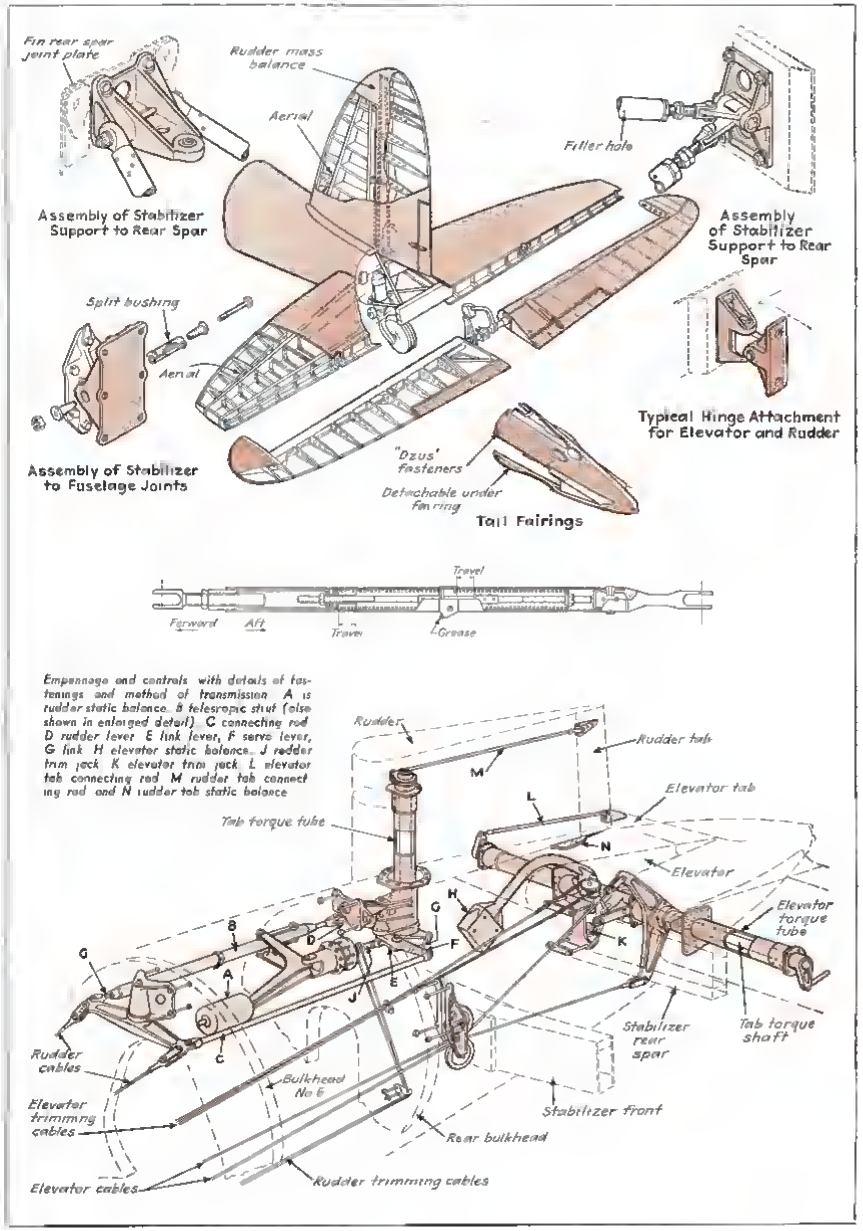
Aileron, elevator, and rudder controls are all operated through cables guided by molded pulleys mounted on sealed ball bearings. In several locations, adjustable tubular connecting rods are used. These are also pivoted on ball bearings.

The control column is a vertical tube hinged at the bottom and surmounted by an abbreviated wheel and a thumb lever for operating the brakes. There is no adjustment on the control column for height or position. The pedals, however, are adjustable for leg length and can be set at five different points about 1 in. apart.

Elevator Control

The control column is connected by an adjustable length tube to the elevator control layshaft beneath the pilot's seat. Cables connect the layshaft with a countershaft mounted on the aft-side of No. 4 bulkhead. These cables are attached to circular pulleys at both ends. The second elevator pulley on the countershaft is oval in shape so as to provide a low gear ratio at small control angles with a progressively higher gearing as the angles increase. Cables run from the oval pulley to levers on the elevator torque tube. Travel limit stops are provided on the layshaft and also a trimming weight. This hangs down about 6 in. below the countershaft center when elevator controls are at neutral.

Elevator trim tabs are controlled by a hand-wheel at the left of the seat. A quill shaft, concentric with the elevator layshaft, is connected to the wheel shaft by chain and sprockets. On the outboard end of the quill shaft there is another sprocket. Motion of this sprocket is transferred to the two elevator trim tab cables by a short length of chain and to the elevator trim jack bolted to back of rear



tail plane spar. Construction of this jack and its location and method of operation by chain and sprocket are illustrated. From rear bulkhead to jack, the cables, chain, and sprocket are enclosed in a sheet metal tube, the top side of which is removable.

Aileron Control

Motion of the aileron control is transmitted to the bottom end of the control column by chains and sprockets connected by rods. Top sprocket is circular, but the bottom one is oval to give a low gearing around neutral position increasing to maximum at full aileron. The oval pulley is connected to a pulley beneath the seat by a tubular torque shaft. To allow for movement of the control column, a universal joint is provided in the torque tube attachment casting. The pulley on the end of torque tube operates two aileron control cables, which pass down left side of fuselage to rear face of rear main spar and thence over ball bearing molded pulleys to the aileron differential pulley.

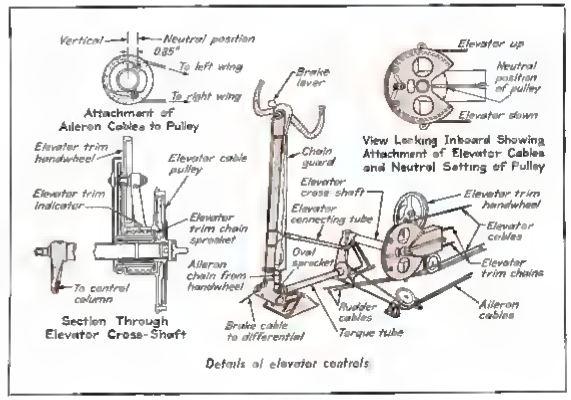
Both ailerons have geared balance tabs. The right aileron tab adjustment is fixed during flight (although adequate adjustment is provided when trimming on the ground) but left trim tab can be positioned during flight. The control with its indicator is on lower right corner of instrument board. This operates with a sprocket and chain, connected to control cables taking same path as aileron control cables to left wing. On the wing a chain and sprocket connection is provided to operate a screw-and-nut type of trim jack.

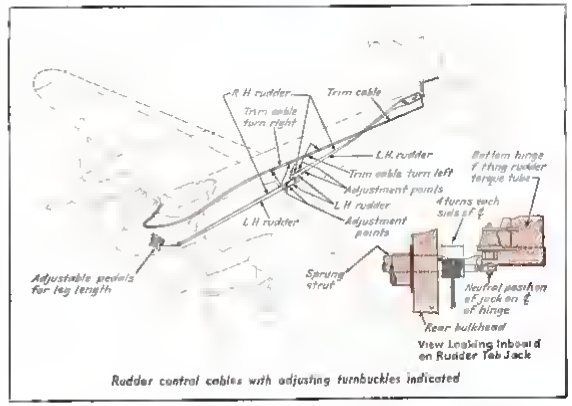
Rudder Controls

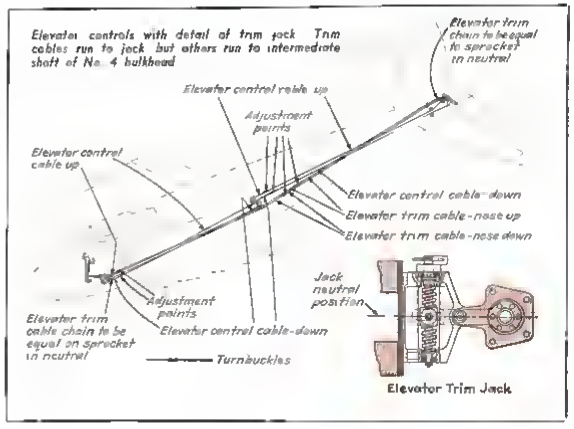
Adjustable rudder pedals are hung from two parallel overhead shafts, the right pedal being suspended from the front one. Two arms on each side of the pedal pad are provided. Each shaft has an arm almost as long as the pedal that is connected to one of the two rudder cables. The latter pass along left side of fuselage to arms of the cable

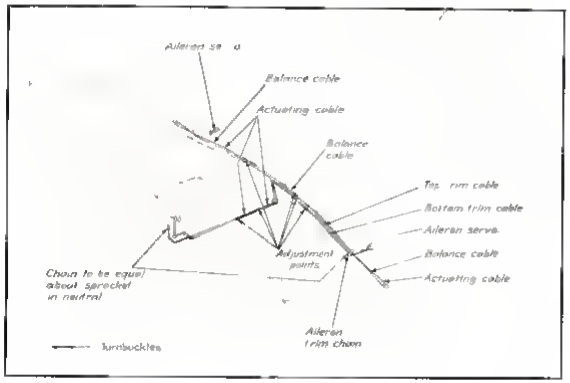
Control Travel

Control column neutral position		5° aft of vertical
At centerline of control wheel	forward	12½°
	aft	12½°
	lateral	none
Elevator travel	above neutral	25° up) −1°
	below neutral	25° down) +2°
Rudder travel		26° (right or left)) −1° +2°
Aileron travel	above neutral	26½° up −1°
	below neutral	14½° down +2°
Elevator trim tab travel, up or down		7½°
Rudder trim tab travel, left or right		16° + 2½°
Left aileron trim tab travel up or down		8½° up or 9½° down
Flaps		45° down ± 2° (max.)

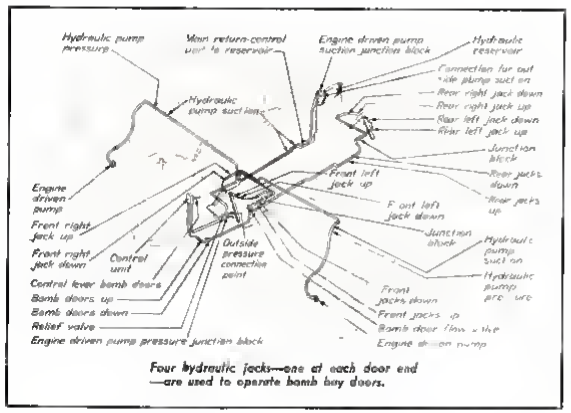




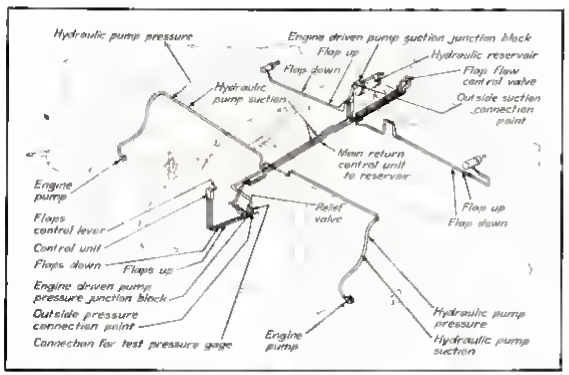




Aileron controls are operated by cables over ball-bearing pulleys. Right hand tab is adjustable in flight, but left hand one is only adjustable on ground



Four hydraulic jacks—one at each door end —are used to operate bomb bay doors.



Hydraulic flap controls draw fluid from reservoir in center of fuselage. Lever control valve is in central instrument panel. Both reservoir and emergency hand pumps may be used for operating landing gear in emergencies.

lever, pivoted on the forward side of No. 6 bulkhead. Bulkhead acts as a stop for rudder pedal movement.

Rudder trim tab is operated by a jack mounted on rear face of No. 7 bulkhead, just below rudder. It is operated by small flexible cables wound on a small drum that forms the nut of the trim jack. At the cockpit and the rudder trim control a Teleflex control box is mounted on the center support of the "V" windshield where its crank control is easy to reach and the indicator showing rudder tab position easily read. The Teleflex cable runs from the control through No. 3 bulkhead. From this point to the tab control drum flexible cables are run over molded ball bearing sheaves.

Rudder tabs not only serve as trimmers but also provide servo action for the rudder. To introduce the servo action a telescopic spring strut is fitted in the rudder control system.

Pneumatic brake control is operated by thumb lever attached to right hand spoke of aileron control wheel. It is provided with finger operated clip so it can be locked in *on* position. A flexible cable transmits brake lever motion to differential control box on floor just ahead of the rudder pedals. Thumb lever merely operates an air valve. The brake control box is also connected to the forward or right brake pedal layshaft. A tubular rod joins the short levers provided at each end. This control divides the braking effort between the landing wheels depending on the position of the rudder pedals. To get even braking, it is only necessary to keep both rudder pedals at center position and control the amount of braking by thumb pressure.

Location of brake differential control valves is indicated in the diagram of the pneumatic system controls.

The pneumatic system controls brakes, radiator flaps, superchargers, and desert air controls, and it has a small single cylinder aircooled compressor on the engine. An air bottle is provided in the after part of the fuselage. Pressure regulator valves, pressure maintaining valve, and oil filters provide adequate volume of clean air. Compressor cylinder is air-jacketed so that a high pressure head of air due to slip speed will be circulated all around it.

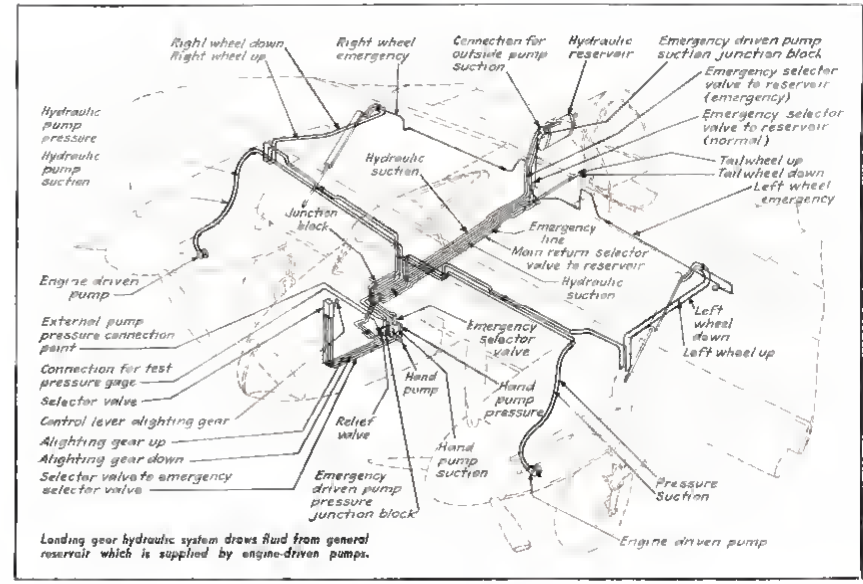
Oxygen System

Since the *Mosquito* is used at high altitude as well as for strafing, a complete system of oxygen tanks is provided. Two different demand regulators and flow meters are provided—one for the pilot and another for the bombardier.

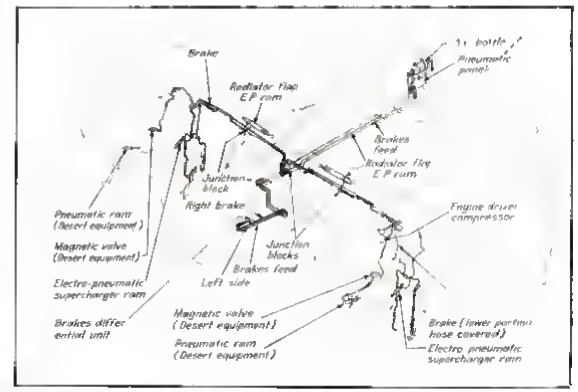
For high flying or in cold weather, hot air from the left air heater is directed into the cockpit. Ordinarily, heat is not taken from the right heater where a duplicate installation is provided. However, for photographic work at high altitude it is necessary to keep the cameras warm, so ducts are provided to distribute heat from the right heater where needed. For long distance missions, an auxiliary oil tank is carried in the aft fuselage, and this also is kept warm by the same means. The regular oil tanks for each engine are located behind the firewalls of their respective engines in the landing wheel bays.

The Mosquito is now being built on North America by the DeHavilland Aircraft of Canada, Ltd. Because shipping requirements made it necessary to purchase all equipment on this side of the Atlantic, many new engineering problems introduced themselves, resulting in a tremendous amount of re engineering before production could be attained. Much credit is due W. D. Hunter, Canadian Chief Engineer, W. J. Jakimiuk, Chief Canadian design development engineer and F. H. Burrell, Chief service liaison engineer, who came from England especially for this project.

Acknowledgement—This description of the deHavilland *Mosquito* was only made possible by the generous assistance and cooperation of the management and Engineering Departments of the deHavilland Aircraft of Canada, Ltd., and particularly Messrs. J. G. Gleave, controller; L. C. L. Murray, executive director; E. H. Starte, assistant controller; W. D. Hunter, chief engineer; W. J. Jakimiuk, chief design development engineer; F. H. Burrell, chief technical service engineer; D. G. Higgins, public relations; Robert E. McIntyre, chief production liaison engineer; C. Don. Long, chief project engineer, and W. H. Jackson, development engineer; Joe Halliday, plant photographer; R. W. Corlett, methods engineer; W. K. Aykroyd, chief draughtsman; C. E. Cowtan, air publications section; H. R. Johns, service inspection; and John Greenaus, Lorne Jans, and F. Willcox.



Landing gear hydraulic system draws fluid from general reservoir which is supplied by engine-driven pumps.



Pneumatic controls operate brakes, air intake flaps, supercharger controls, and radiator flaps for regulating engine temperature. Compressed air is supplied by left-hand engine-driven compressor and is stored in bottles for emergency use.

LET'S MAKE INSTRUMENT FLYING EASIER

By JEAN H. HAMELET,
Flight Captain, Consolidated Vultee Aircraft Corp.

A flying man's plea to the engineers—calling for complete re-design instead of mere re-grouping of blind flying instruments. The "Cross System" he advocates makes sense, answers the express needs of many pilots.

AIRSPEED 130, heading 110, altitude 5,000. Listen, that on-course signal is building up pretty fast. I better start turning to the right. Left. No, right, of course. Wait a minute, what's the heading of that leg—142? Yes, that's right. But watch that airspeed—is it 135 or 125? Oh, 135. Better pull up a little. And that gyro horizon was not set so well, after all. On course coming fast. Let's turn a little more. Altitude, Oh! oh! that needle moved to the left. Heading, airspeed, altitude, ball in the center, what time is it—33? No, 32. Should be over the cone in 7 min. 32 plus 7 is 39. Yes, 39. Let's call the tower. 135, 130, 39 5 000. Airspeed, altitude, climb indicator, gyro, horizon. gyro, heading, altitude. Let's keep our eyes moving, as they say in *THE BOOK*. Watch the instruments. Hell! I sure keep them moving, and my neck, too. I can't see that altimeter behind the wheel—or if I see it, I can't see the gyro! Listen, it's a faint *N* now, 135, no, 145 will do. 130, 39. Barnesville Radio, Barnesville Radio. (Watch that heading, you fool). This is number so and so."

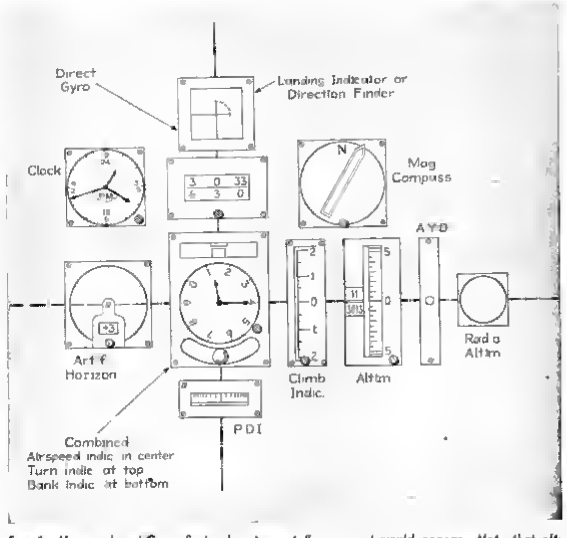


Fig. 1. Here is how 'Cross System' instrument flying panel would appear. Note that altimeter and climb indicators are on vertical lines, while those for maintaining heading are on horizontal line. Airspeed and bank-and-turn indicators have been combined in one dial.

That, gentle reader, is a quick glimpse inside the brain of a pilot flying on instruments—not one of those veterans with so many hours on instruments that the beam seems to follow them but just an ordinary nonsuperman flyer.

There are, of course, many one-man orchestras boasting outstanding careers. One well-remembered gent, for example, played drums with his right foot, a sort of xylophone with his left, a violin with his hands, and a flute with his nose. The tune was *Tipperary*. But this is the Century of Progress, hence *Tipperary* is now nearly forgotten. Today it's *Mairzy Doats* and we seem to ask our pilots—some of them young pilots with few instrument hours—to cheerfully sing *Mairzy* while hitting a cone.

One of the main reasons they find it well nigh impossible to even graze the cone (let alone tackle *Mairzy*) is the lack of standards in panel placement of the ever-increasing number of instruments. One plane will have them arranged one way, another craft will have them in a completely different pattern. *The Book* says the basic instruments—airspeed, turn-and-bank, altimeter, climb indicator, and clock—must be mounted close together.

They are. But who would use the basic instruments for a smooth range flying a big modern plane? It is impossible to do a good job without the gyro instruments—the artificial horizon and directional gyro—and there are such others as the direction finder, radio compass, landing indicator, or radio altimeter. Yes, and there'll be more in the future.

Unless some logical disposition is adopted for all these instruments, pilots will have increasing difficulty getting accustomed to the new types of airplanes.

But what is just as important is the makeup of the instruments themselves. Almost without exception they have round dials, with one, two, or even three needles each. The cockpit of a modern plane has become a nightmare of crazy clocks which read 6,500 ft., 230 deg., 170 mi (or maybe knots), 32 in., 2,200 rpm., right turn, and 30-deg. bank. There is even one that gives the time, surprising as it may seem, although it does so in a crazy way, as will be shown. All these needles move to the right, to the left, up, or down—with no more apparent reason than individual fancy.

Some efforts have been made, it must be conceded, to simplify things. Apart from the fact that the four or five basic instruments are grouped together, most plane makers also place the gyro instruments side by side, also dispose the engine instruments so that the vertical position of the needles corresponds to cruising speed. This is an excellent idea, since a glance will, accordingly, tell if something is wrong.

This is, in fact, the very principle which the writer would apply to *all* the blind flying instruments.

As will be seen in Fig. 1 some of the instrument dials would have unusual shapes. Even the central instrument looks strange—being an airspeed and bank-and-turn indicator combined in one.

But note this! All the instruments actually used to keep the *heading* are on a *vertical line*. All the instruments used in keeping the *altitude* (including the *attitude* of the plane in a climb or glide) are on a *horizontal line*. This is what we will call the *Cross System*.

Note also that, wherever possible, round dials have been eliminated—for, as more than one pilot has said, "all those things going in circles make you dizzy." Well, doesn't altitude suggest the idea of a vertical scale? Okay, our altimeter *looks* like a vertical scale. So does the climb indicator. The directional gyro, though, is on a *horizontal* scale. As for the central instrument, the pilot can rotate the whole airspeed indicator, dial and needle—to set it so that the needle points horizontally to the right (in the illustration it shows 140 mph.). This means that in working an orientation problem with an airspeed of, say, 140 mph. at 11,000 ft., it isn't necessary to watch all the individual instruments on the horizontal line.

If the nose of the airplane moves up, all the needles on these instruments will move upward—not simultaneously, of course (for they have different lags) but all in the same direction. If the nose of the plane drops, all these same needles will move down. Their movement will be so obvious that the pilot may concentrate entirely on the vertical line, especially on the directional gyro and the turn indicator, which have been put as close as possible, one above the other.

The magnetic compass, which is not used to actually hold a heading, is placed, along with the clock, to one side, for both are instruments consulted only from time to time.

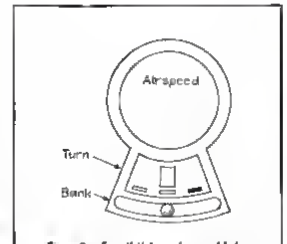


Fig. 2. Feasibility of combining airspeed with bank-and-turn indicator is shown by this type, manufactured in Europe for many years.

Despite their unusual shapes, there is no special difficulty in making these instruments. A combined airspeed and turn indicator, for example, has been manufactured in Europe for years, although in a somewhat different way (see Fig. 2).

The only graduation which would show on the proposed altimeter dial would be between plus-500 and minus-500 ft. The thousands-of-feet would appear in a small window just above the altimeter setting. From the side, this instrument would appear like a drum, as shown in Fig. 3. The rate-of-climb indicator dial would appear much the same, graduated from plus-2 000 to minus-2,000 ft., which appears adequate.

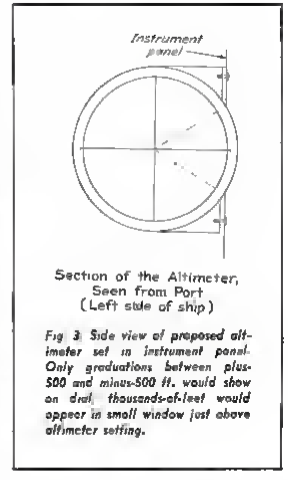
The artificial horizon has a figure (plus-3 in the illustration) showing in a little window. Different figures correspond to different positions of the little airplane image above or below the horizon, for the figure-showing device is connected with the knob used to reset the silhouette. The idea is this: Usually the resetting of the plane image after a change of power or airspeed, or both, is done after the new position of the ship has been held for a certain time. This is a waste of time. With our device, it will be easy to memorize which figure corresponds to such power and such airspeed. Before we adopt a new power setting, we will bring the new figure in the window with the resetting knob, changing at the same time the position of the plane image. Then as soon as the new power setting is obtained, we'd simply bring the horizon back on the image with the stabilizer.

This device should come in pretty handy during the flap lowering operation, as leading the airspeed indicator is rather difficult with flaps lowered. Instead of waiting for the new airspeed to be obtained after lowering the flaps, and only then resetting the artificial horizon, we will do the resetting first, then lower the flaps, adjust the power, and bring the silhouette back on the horizon with the stabilizer, thus stabilizing the airplane immediately.

It may be noted in Fig. 1 that our clock has a 12-hr. dial of the good old grandfather type, with only a little difference. The numbers 13, 14, 15, etc., are also shown on the dial, below 1, 2, 3, etc., also a P M. mark appears—automatically of course—on the dial when you must use the bigger numbers.

We have been brought up with clocks which showed 12 at noon, but now the fashion seems to be clocks which show noon at six!* To avoid a 12-hr. error, which nobody should make, we risk a 1-hour error, which is much more dangerous because it is much harder to detect. A 12-hr. dial clock is an instrument to which we are so much accustomed that we often won't have to look at it closely to know the time.

And this is exactly what we want—to make things as easy as possible for the poor fellow behind the wheel. Some people will think that we are too old, but I would like to see them "on instruments," trying to figure if "7" is really between "6" and "8", as shown on the new super-duper 24-hr. dial clock.



Section of the Altimeter, Seen from Port (Left side of ship)

Fig. 3. Side view of proposed altimeter set in instrument panel. Only graduations between plus-500 and minus-500 ft. would show on dial, thousands-of-feet would appear in small window just above altimeter setting.

Naturally, we want all the instruments on the horizontal bar of the cross to show above the wheel for convenience of a pilot of average size. Seat adjustments could be provided for basketball players and for undersized fellows.

Needless to say, *Mairzy Doats* will have long been forgotten before our remarkable inventions are adopted. Our lucky instrument flyers of the future will have to whistle another tune. But meanwhile—from one who learned the hard way—here is a prayer: "Please, dear engineers, no more of this hide and seek with the directional gyro or altimeter—or both."

* The new Navy clocks have their dial divided into 24 units instead of 12, thus actually showing 6 when it is 12 o'clock.

Automatic Flight And Airplane Stability

By STEPHEN J. ZAND

Director, Vose Memorial Laboratory, Sperry Gyroscope Company, Inc.

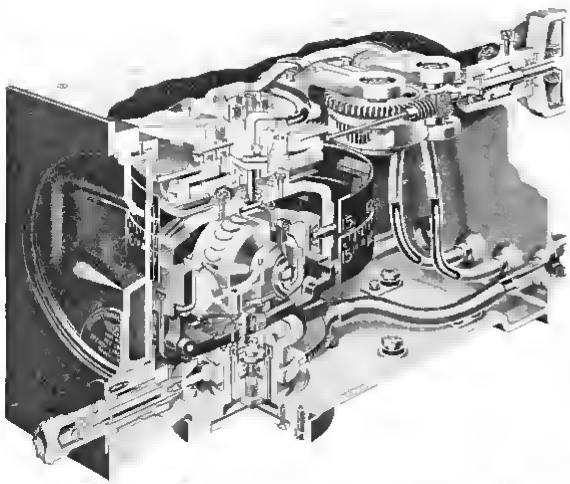
A complete understanding of the fundamentals of the automatic pilot requires a specialized review of airplane stability. Mr. Zand's approach to a clear description of automatic flight principles is a notable technical reference work.

AMONG THE MANY INSTRUMENTS used on airplanes the automatic pilot, conceived in one form in 1913 and introduced commercially in many forms about 1933, has become standard equipment now and achieved such prominence that the time has become ripe to acquaint the engineers with fundamental principles of this device. The usual discussion of purely constructional details can be obtained from reading the extensive trade literature.

It is customary to preface an article of this nature with a chronological and historical outline of the development of the device. In this case we shall omit this introduction because to do justice to the broad subject, to give credit to all designers, inventors, experimenters and manufacturers, one would have to write almost a book. The subject is fascinating in itself and fortunately for us, has been thoroughly covered by a series of papers written by the Belgian scientist F. Houssay in 1935 and 1936. His work was translated and published as a technical note by the NACA, and is therefore available for the student of aeronautical history.

Automatic Pilot Defined

The automatic pilot should be a substitute for the airman, (we use the term "airman" rather than human pilot to avoid confusion), by using two entirely different words all ambiguity in reference to the flying functions will be avoided).



Sperry directional gyro which actuates the rudder and serves to maintain the airplane on a fixed course while plane is under automatic pilot control

In other words, one sets as desideratum that the automatic pilot keep the airplane on a trajectory chosen by the navigator in such a way that safety, economy, speed, altitude, comfort, etc., give the best all around compromise. Once this trajectory is established and reached, the automatic pilot should keep the airplane rigidly on it which implies that the c.g. of the airplane will follow a predetermined line or curve in space, further that the motions about the c.g. of the airplane are eliminated. Under such conditions the airplane follows a chosen geographic direction, its speed remains constant and its altitude above a chosen reference line such as sea level remains unaltered. Such ideal flight is of course possible for a short time interval. Practically, the motions about the c.g., and the displacements of the c.g. will not be completely eliminated. They will occur, but a good automatic pilot will always bring the airplane back to the chosen trajectory, and the integrated path will be substantially as originally planned. The better the design of the automatic pilot, the smaller should be the momentary departures.

Attacking the Problem

If we were assigned the task of designing an automatic temperature control for an icebox, only the most inexperienced engineer would proceed immediately and embark on the exploration of the available thermostats, switches, wiring, etc. Any logical person would attack the problem from a basic point of view. He would find out such things as how much refrigeration is required, how much heat is radiated in the icebox without automatic control, what is the rate of heating up of the food cabinet, what is the heat absorption of the food customarily stored and so forth. Only after all those elements have become thoroughly investigated and translated into engineering language by means of formulas and charts, would one proceed to design suitable control elements. The chances of the successful accomplishment of our assignment in following this method is much greater than if one embarks blindly on the design problem without studying the underlying fundamentals. Many other analogies could be described. All of them would lead us to conclude that in order to be able to design a successful automatic pilot, and apparatus controlling the motions of the airplane we have to get intimately acquainted with the free, unrestricted motions of the airplane. Consequently, a thorough knowledge of the stability of the airplane is a pre-requisite toward the successful solution of the problem of automatic flight.

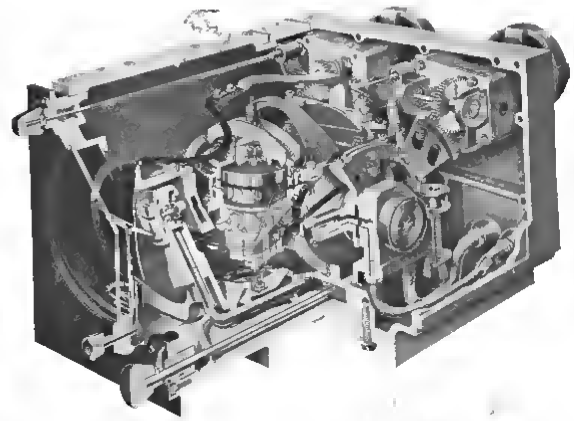
Static and Dynamic Stability

Since the beginning of aeronautics it has become customary to divide stability into two separate studies: static stability and dynamic stability. The reason for this division lies probably in the fact that designing the airplane so as to have it statically stable i.e., in such a way that when displaced from a given attitude, it sets up forces and moments tending to restore it to the original attitude, is fairly easy. The computations involved are

algebra and arithmetic. Relatively simple criteria establishable in the wind tunnel suffice since static stability is directly proportional to the slope of the moment curve.

Dynamic stability on the other hand is much more complicated since it involves the study of the motions due to static stability. In pursuing this work we have to ascertain whether the ensuing motions are stable and whether the oscillations resulting from the airplane's return to its original trajectory are quickly damped out.

Bryan in 1911 was the first to write a treatise on dynamic stability. By assuming the airplane to be a rigid body, he showed that the complicated motions could be separated into as few as two major components, a symmetrical motion along the pitch axis and an asymmetrical one along the roll and yaw axis. Bryan's work was extremely interesting and very thorough, especially if one considers the time when it was written. But it is understandable only to a highly trained physicist and first class mathematician. To the aeronautical engineer it gives very little insight into the workings of dynamic stability as the practical side and design criteria are not treated at all. It was Jerome Hunsaker who, in 1915 and 1916 in his famous Smithsonian paper presented for the first time a method of attacking the problem from which definite practical conclusions could be drawn. Later on many other scientists added to this knowledge. Notably Melville Jones, Dr. Bairstrow, Glauert, Price and many others published numerous works bringing the problem progressively nearer a practical engineering solution. The study of dynamic stability has progressed by now to a point where one can predict from the theoretical conclusions practical results. The agreement after test flights are made is surprisingly close.



Bank and climb control unit of the Sperry Mark III automatic pilot which controls aileron and elevator movement when airplane is under control of the automatic pilot

Basic Equations

This fact is gratifying and encouraging but let no one think that either the theoretical or the practical work is simple. Both are extremely laborious at best. The purely mechanical part of the calculations is time-consuming and unless properly organized, may lead to utter confusion.

For all practical purposes the airplane may be regarded as a rigid body. Six equations are therefore, required to define its motions: three force equations and three moment equations. These equations must include forces and moments due to aerodynamic reactions and those due to mass reactions. Obviously to make the setting up of the basic Newtonian equations easier, we must choose a convenient system of cordinates. We choose, of course a Cartesian system, and the proper origin of the system is best taken as the c.g. of the airplane. Then we proceed, as in all problems of dynamics, to equate mass acceleration along each axis to the appropriate component of the applied force. Further, by equating rate of change of moment of momentum about each axis to the appropriate applied moment, we obtain the six basic equations which must be satisfied throughout the motion of the airplane. Using NACA conventions and notations we can write:

$$m\left[\frac{dU}{dt} - VR + WQ\right] = X - mg\sin\theta$$

$$m\left[\frac{dV}{dt} - WP + UR\right] = Y + mg\cos\theta\sin\phi$$

$$m\left[\frac{dW}{dt} - UQ + VP\right] = Z + mg\cos\theta\cos\phi$$

$$\frac{dh_1}{dt} - h_1R + h_2Q = L$$

$$\frac{dh_2}{dt} - h_2P + h_1R = M$$

$$\frac{dh_3}{dt} - h_1Q + h_2P = N$$

where the velocities about the X, Y, Z axes are denoted by U, V, W forces by X, Y, Z. The angular velocities are P, Q, R, moments L, M, N. The moments of inertia are A, B, C, the product of inertia D, E, F and finally the moment of momentum we will call h_1, h_2, h_3. The expressions for the moment of momentum can be derived from the following three relations:

$$h_1 = AP - FQ - ER$$

$$h_2 = BQ - DR - FP$$

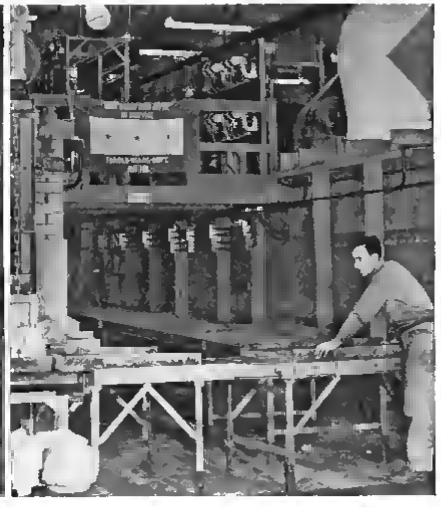
$$h_3 = CR - EP - DQ$$

Solution of Equations

The general solution of the basic equations could perhaps be accomplished by means of the so-called "step by step" method. The maze of mathematical expressions soon loses practical significance, however, and in order to make our work practical it is necessary to adopt certain simplifications. Naturally, those simplifications have to be reasonable and based on logic. Sir Melville Jones treats the subject, both the solutions of the equations and the simplifications adopted, very masterfully. His work can be found in Volume 5 of the *Aerodynamic Theory* edited by Durand. Diehl in his book "Engineering Aerodynamics" gives an excellent review of Jones' work and shows how the stability biquadratic is derived. The simplifications generally accepted are first to assume that the departures from the initial state are small both in respect to angles and to velocities. Then the second order products become so small that they can be neglected. Taking this into consideration we can say that the X, Y, Z, forces will be a function of U, V, W, P, Q, R. We don't know however, what the function is. Fortunately, for small oscillations we can perfectly legitimately expand this function by the MacLaurin theorem and obtain expressions (by neglecting the second order terms of course) for the aerodynamic force derivatives. They will be partial derivatives which can be substituted for the mass forces in the previously described six equations of motion. The results of the substitution can be grouped into two sets of three linear differential equations with constant coefficients: the first in U, W, θ the second in V, ψ, ϕ. Since experience shows us that motions are of an oscillatory nature, we deduce that each variable must be some function of $e^{\lambda t}$. Then each group of three equations can be combined into a biquadratic of a general form $A\lambda^4+B\lambda^3+C\lambda^2+D\lambda+E$ where A, B, C etc. are functions of the stability derivatives and λ is the damping coefficient. The solution of the biquadratic presents serious mathematical difficulty since as we all know no general solution of any equation above third degree, exists. Fortunately, approximate solutions have been found and since, very broadly speaking, all airplanes are somewhat alike the order of magnitude of the stability derivative and, therefore of the coefficients A, B, C etc., will be comparable. Consequently once a pattern for a solution is found, a subsequent refinement and adaption to a variety of

(*Turn to page* 290)

Mounted on column of Bullard Mult-au-matic this forgat fixture assists in rapid locating of cylindar head forgings



Loading end of continuous conveyor gas-electric heat-treating furnace used for treating cylindar head forgings

Forged Cylinder Heads Require New Technique

Cutting a cylinder head out of a solid block was always considered "quite a trick, if you can do it". This is the story of how it was done.

PUBLICLY ANNOUNCED 18 month ago, the forged cylinder head for Wright *Cyclone* engines was not immediately placed in production due to time required for obtaining special machining equipment, now installed and in full operation.

Production of forgings was left to companies specializing in this work equipped with the extremely heavy presses and upsetters essential to these operations. Heads are delivered in "as forged" condition, and weigh approximately 65 lb. First step is heat treatment, and is extremely critical. Machining speeds and feeds are so high that even slight differences in heat treat and consequent material structure will appreciably affect tool life and quality of finish.

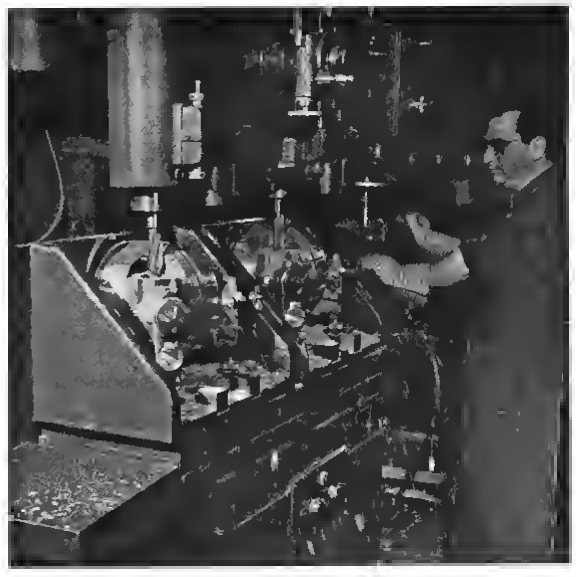
Continuous conveyor gas-electric furnaces are employed, in pairs with a gravity roller conveyor between them for return of the carrier trays. Nine forgings are loaded on to a tray made of subway grating, and two of these are placed on the loading extension of the furnace. A hand crank moves the trays into the furnace vestibule. Power-driven rollers carry the trays through the first heating section where they remain for 6 hr. At the end of this period the trays reach the discharge door which opens automatically while at the same time a high speed driving mechanism ejects them on to the cooling conveyor with the minimum loss of furnace heat. Forced draft cooling is employed, air being driven upward into the hollow base of the forgings, which are then loaded automatically into the second stage furnace from which they are again ejected, cooled, and loaded into the third stage. After the final cooling the parts are removed from the trays which are then returned gravity conveyor.

In the first machining operation the parts are mounted in chucks, resting on equalizing buttons, and are held by the chucking piece. Before first cut is taken work is trued up by targets and flush pin gauges on the machine column, supported that they may be raised out of the way to allow the machine to index. Outside is finish turned, flange finish formed, and first fin groove finish turned, then transferred to a second Mult-au-matic in an inverted position. The chucking piece faced off, and the interior dome rough and finish formed.

Locating holes are now drilled and reamed on an Allen drill. This is a three position indexing machine having two two-spindle heads and three trunion-mounted fixtures to facilitate loading. Parts are loaded in an upright position, locating on the flange diameter, and targeted on the rocker boxes. After clamping the fixture is inverted to present the base of the flange to the drills.

Heads are next conveyed to a Cincinnati Hydro-matic Rise and Fall machine on which the upper curve is profile milled, after which they are mounted on carrier plates before passing to the Greenlee transfer machine. Parts are loaded into the first, or 16 station section, so that the rear of the head faces the right side of the machine, and at the first operation both rocker box faces are rough milled, removing about $\frac{1}{16}$ in. of stock with end cutting mills. At the next operation a $\frac{1}{2}$ in. hole is drilled and reamed,

Cross section through Cyclone forged cylindar head showing complicated forms machined in ports and rocker box.



Part faces are rough and finish milled on two-spindle Cincinnati profile millers

and then the two spark plug holes are drilled, counterbored, and chamfered. A hydraulically operated arm now picks up the head clear of the conveyor, tilts it to remove chips and oil, and replaces it.

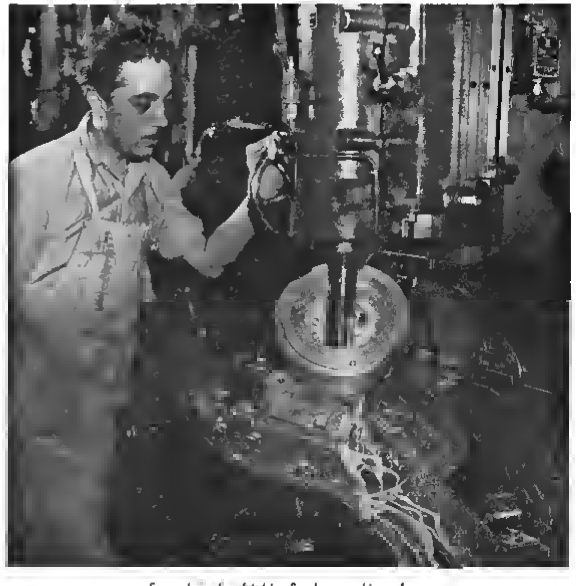
At this point a manually operated turntable is incorporated in the track to enable the second operator to turn the head a quarter turn so that the rocker boxes face lengthways of the machine. This operator then advances the head into the second, or 35 station section where the first operation consists of drilling two $\frac{11}{32}$ dia. holes near the ends of each rocker box and rough counterboring the valve spring counterbores to $1\frac{11}{32}$ dia. the valve holes are next drilled $\frac{3}{4}$ in. dia. through into the dome and finish counterbored to $2\frac{1}{8}$ in. dia.

Opposite or push rod ends of the rocker boxes are then rough and finish counterbored to a spherical radius. A clearance recess is end milled at valve ends and then push rod holes are drilled through and counterbored. At next station rocker shaft holes are drilled, after which a $1\frac{1}{8}$ in.-wide slot is milled between valve and push rod counterbores. Finally two holes are drilled and reamed for the fin bracing and thermocouple tubes, the latter being also counterbored.

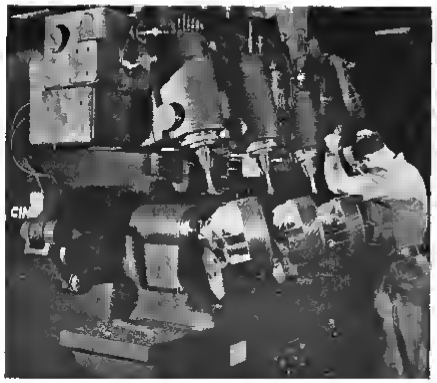
Head is again raised and inverted to remove oil and chips and advanced to the third or twelve station section. Before this, the part has passed through the section for rough and semi-finish counterboring the valve seats. Emerging from here it is tilted to remove chips, righted, and passed through an automatic wash machine.

Next machine comprises a total of 63 stations, of which 23 are active, or operating, three are loading, three unloading, and the remainder serve to allow access to the tools. It has a length of 110 ft., and is equipped with a total of 41 tools to perform 40 operations. These include 4 milling cutters, 15 drills, 3 reamers, 17 counterbores, and 2 end mills.

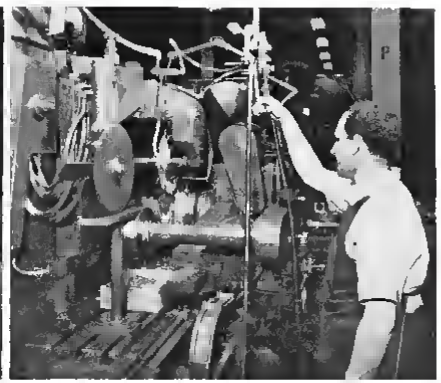
After the wash machine, heads travel by conveyor to Snyder mills equipped with three inclined spindles each driven by its own high speed motor. Parts are



Special inclined-table Snyder machines form complicated intake and exhaust valve chambers



Specially designed Cincinnati Hydro-tel high-cycle motor driven profiling machines generate form of intake and exhaust ports.



Rotary cam and follower guide twin saws which shape body fins on Cincinnati Hydromatic mill.

located by the carrier plate on which they passed through the Greenlee, and are clamped to a power operated table. The spindles feed to the depth of 0.175 in., and the table then advances to produce the .5 in. slot. After finning, these slots receive fin bracing reinforcing strips.

Carrier plates are now removed and the parts passed to Allen drills provided with a four-position indexing table and three drill heads, each having eight spindles. The cylinder heads are loaded in an inverted position, locating by the dowel holes and the center bore. At the first index the drills start the holes to a depth of approximately ½ in. at the second the holes are drilled through and at the third are reamed and countersunk. At a later operation anchor tubes are inserted into these holes to serve as fin braces.

The next operation consists of machining out the exhaust valve chambers so as to leave a central truncated cone in the form of a portion of a helix. This somewhat difficult form is generated on a Snyder machine built to Wright designs. The part is held on a rotary fixture inclined at the angle of the valve guide cone, located on the valve spring counterbore and rocker box slot. The form end mill used is .030 smaller in diameter than the required width of the cut, and is fed in to finish depth for the roughing operation as the part makes one complete revolution on the table. The tool is then set over .015 in. toward the inner side of the cut for the finishing operation and then .015 in. toward the opposite side for finishing the other side of the cut. For finishing, rotation of the head is reversed to produce a climb cutting action and obtain a fine finish. The intake valve chamber is similarly machined on Snyder equipment, but with the table set to suit the different angle.

The faces of the intake and exhaust ports are rough and finish milled on two spindle Cincinnati profile millers on which the heads are loaded two at a time, locating on flange and dowel holes and clamped through intake and exhaust valve guide holes by plates bearing on the rocker box faces. End mills machine port faces and adjacent sides of head, movement being controlled by a master template. After intake port face has been machined, tracer is shifted to a second template for machining exhaust port faces. Dry carbide tipped cutters are used.

Intake and exhaust ports are milled out to valve chambers. A high speed Cincinnati Hydro-tel profiling machine was designed for this purpose, and is equipped with three individually powered spindles each driven by a high-cycle motor to rotate at 6,900 rpm., power for which is provided by a high cycle converter. The spindles are inclined at an angle of 15 deg. from the vertical, but feed is vertically downward. Three heads are located at one time by hardened blocks fitting the rocker box slot.

As the spherical cutters feed down into the work they travel in an approximately circular path, being controlled by a ball ended tracer operating in the master form. The curved passage thus generated is remarkably clean and requires only a smoothing operation with abrasive cloth to remove tool marks and blend it into the opening of the valve chamber. Approximately 15 min. are required to perform the operation on the three heads for the exhaust ports, and a similar time for the intake.

Milling out the fins is done by Cincinnati milling machines designed for the job by Wright and Cincinnati engineers. A standard mill was modified by reducing the load on the feed screws to less than five pounds by means of weights and pulleys. Two Keller attachments were connected to the table, one for the vertical movement and one for the horizontal, to follow a master profile, and thus the first heads were successfully produced. Considerable trouble was encountered with the cutters. Gang milling was tried unsuccessfully and standard milling saws were found to be entirely unsuitable since their harmonic frequency produced fractures. Special cutters were designed, vibration was dampened and excitation no longer occurred. Thirteen inches in diameter, equipped with nine finely finished carbide tipped teeth, these cutters produce an exceptionally good finish when operating at a surface speed of 4,500 fpm. and a feed of 70 in./min. Heat generated is virtually negligible and both cutter and work piece remain sufficiently cool to be handled without difficulty.

When first installed it was believed the

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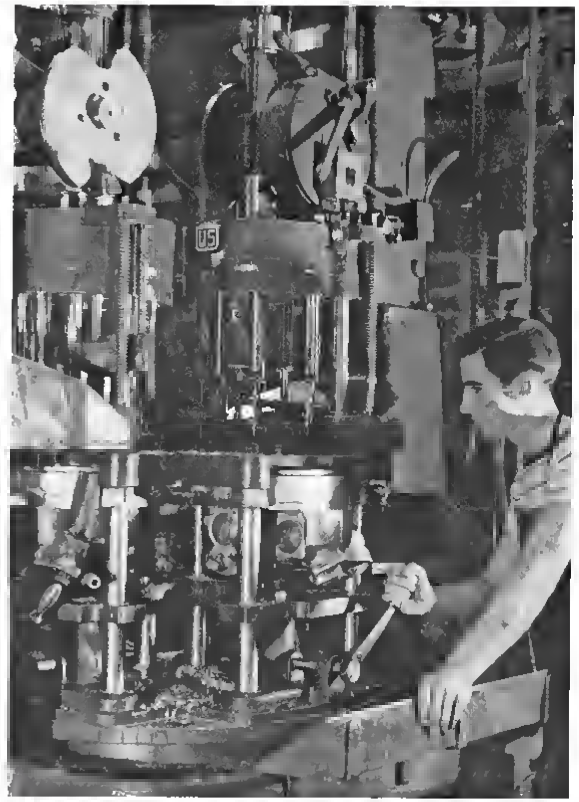
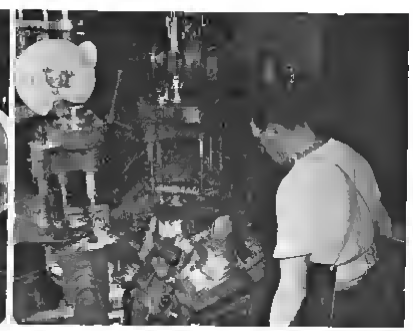


With three heads and four-position indexing table this Allen drill drills, re-drills and reams eight holes for fin bracing tubes.

Fins on curved upper surfaces are milled by Cincinnati machine which holds eight heads at one time.

One of first experimental machines for cutting fins on forged cylinder heads. Cutters runs at speeds approaching those used in woodworking.

Slots for fin braces are cut on this Snyder milling machine using several independent electric motors.



Allen drill equipped with specially designed turnover fixture locates, drills and reams dowel holes.

Load Characteristics Of Cellulose Acetate Plastic

PART I

By **WILLIAM N. FINDLEY** *Assistant Professor of Theoretical & Applied Mechanics*
College of Engineering, University of Illinois

Wide application of cellulose acetate plastic in aviation have given rise to further comprehensive studies of their load resisting properties. This series presents an exhaustive analysis of particular interest to designers and engineers.

CELLULOSE ACETATE is widely used both for civilian goods and in military applications. Typical military applications are transparent airplane cockpit enclosures, gas masks, oil cans, airplane control knobs, high impact resistant flashlight cases, and fire-resistant photographic film. Mechanical strength and toughness are the outstanding characteristics of cellulose acetate which have indicated its use in such applications.

In order to obtain more complete information on the mechanical properties of cellulose acetate and to determine the effect of certain variable conditions involved in service and testing technique, the tests described here were undertaken.

The following mechanical tests will be considered in the present discussion: "Static" strength tests in tension, compression, and torsion, also fatigue tests and creep tests. Some of the variables whose effects were studied include the effect of speed testing in both static tests and fatigue tests, the effect of moisture content, the effect of range of stress in fatigue, the effect of stress on the creep in tension, and the effect of moisture content (humidity).

Tests have shown that several factors which are unimportant in the testing of metals must be controlled during tests of cellulose acetate and most other plastics. Among these are small changes in temperature, relative humidity, and speed of testing. The effect of temperature and humidity was so serious that all tests had to be conducted in a laboratory especially constructed to provide constant temperature (77°F) and constant relative humidity (50 percent). Many of the tests also required the development of special machines and instruments, since available equipment was unsuited to tests of this material.

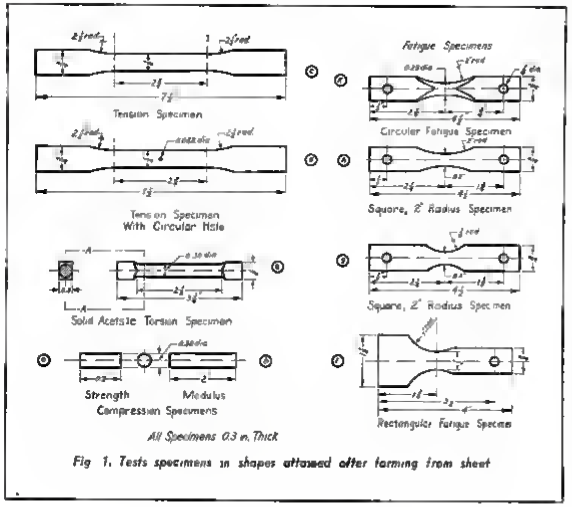


Fig 1. Tests specimens in shapes attained after forming from sheet

Materials and Specimens

The cellulose acetate plastic for these tests was supplied by the Plastics Div, Monsanto Chemical Co. The material was a clear, transparent thermoplastic composed of medium viscosity cellulose acetate of the acetone soluble type, plasticized with about 26 percent of phthalate and aromatic phosphate ester plasticizers. The Monsanto formulation number was 2050 TV.

All specimens used in these tests were cut from the same sheet of cellulose acetate plastic. This sheet was 0.3-in. thick and was made by the sheeter process, at a molding temperature between 200° and 250°F. The finished sheet contained less than 1 percent of residual solvent and water, and it had a Rockwell hardness of about L40 at 77° F, 50 percent relative humidity.

A drawing of the specimens used is shown in Fig. 1. All specimens were machined with the longitudinal axis parallel to the short side of the original sheet. The specimens were cut from the sheet on a jig saw, then milled or turned to the shape shown in Fig. 1. Machined edges were then smoothed by hand with No. 00 emery paper so as to remove all burrs and scratches, leaving the final polishing marks parallel to the axis of the finished specimen.

The compression specimens were not smoothed after machining because of the fact that slight surface scratches would not affect the results, inasmuch as the material did not fracture under a compressive load. All specimens were conditioned by allowing them to remain in the atmosphere of the testing laboratory for a period of at least two weeks prior to the start of the tests, and they were kept in the laboratory continuously thereafter. The laboratory was maintained at a constant temperature of 77° ± 1 F and 50 ± 2 percent relative humidity continuously throughout the duration of the tests.

As for the effect of rate of strain on tension, compression, and torsion tests:

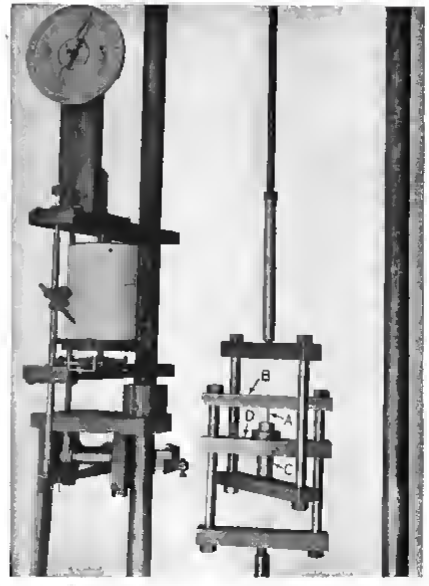


Fig. 2. Universal testing machine, used for compression, tension, and torsion tests, is equipped for variable speeds by series of V-belt drives. Rigged for compression tests (as seen here), a compression tool is employed to avoid possibility of eccentric loading of test specimens. The specimen A was compressed between the upper platen B and the cylinder C. The cylinder was guided in the yoke D so that the cylinder face was always parallel to the upper platen. Thus, if precautions are taken to machine specimen ends parallel and to center the specimens eccentric loading will be negligible.

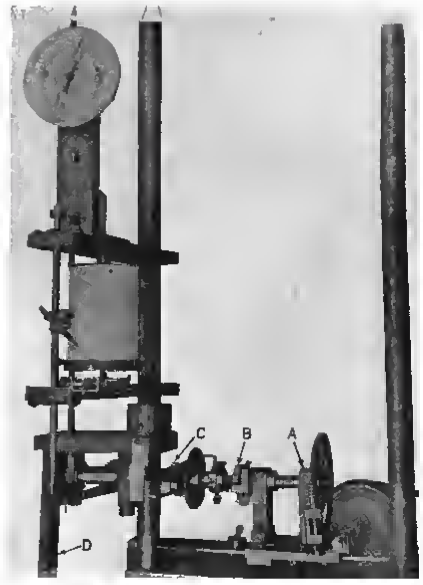


Fig. 3. Special apparatus used for torsion testing. The pendulum weighing system of the tension testing machine was used as the torque-measuring device, this being accomplished by attaching a twisting tool is employed to avoid possibility of eccentric loading of test specimens. The specimen A was compressed between the upper platen B and the cylinder C. The cylinder was guided in the yoke D so that the cylinder face was always parallel to the upper platen. Thus, if precautions are taken to machine specimen ends parallel and to center the specimens eccentric loading will be negligible. head A driven by a double worm drive. A special chuck B was attached to the twisting head shaft, and another chuck C was fitted to the axis of pendulum D. These chucks were designed to apply a torque to specimen with little danger of bending specimen at same time. This was done by mounting specimen on centers and applying torque as a couple by means of adjustable screws.

Static tension, compression, and torsion tests were made on specimens of the shape shown in Figs. 1c, 1b, and 1e, respectively. These tests were performed in the universal testing machine shown in Figs. 2 and 3.

Compression tests were made on specimens 2-in. long and of about 3/10-in. dia., so the l/r ratio* was about 27. This length of specimen was necessary in order to accommodate the compressometer. The compressometer had a gage length of 1 in. and consisted of a 1-to-1 lever to which was attached a dial registering in one-thousandths. The instrument was attached to the specimen by means of pointed screws on opposite sides of the specimens, so that the strain measured was the average strain in the specimen.

Compression tests performed on the 2-in. specimen were used to determine the modulus of elasticity and shape of the stress-strain diagram in compression. A still longer specimen would be desirable to increase the accuracy of strain measurement. Effect of buckling would, however, become more serious with longer specimens. In order to obtain values of compressive yield strength a shorter specimen, about 9/10 in. long, was used.

The l/r ratio for the short specimen was about 12. The yield point observed with the short specimens was 4,900 psi at a rate of strain of about 0.002 per minute.

Special apparatus was designed and built for torsion testing of plastics because machines of low capacity were not available. The apparatus used is shown in Fig. 3.

Shearing strain (in the torsion test) was measured by means of the instrument shown in Fig. 4. This instrument measured the angle of twist of the specimen and was designed to accommodate materials whose ultimate shearing strain was relatively small, also materials which might twist two or three revolutions in a length of 2 in.

Torsion tests differ from tension and compression tests in two important respects. They differ in respect to the state of stress developed and in respect to the stress gradient. State of stress may be defined in terms of the ratio σ_{max}/τ_{max}, i.e., the ratio of the maximum tensile stress to the maximum shearing stress at a point in the stressed member. In a tension member, this ratio is 2, while in a torsion member it is 1. Thus it may be that some materials will behave much differently in the two tests.

Stress gradient is a measure of the distribution of stress over the cross section of a member and is equal to the slope of the stress distribution curve—

$$\frac{d\sigma}{dy}$$

It has a value of zero in a tension member, but it can never be zero in a torsion member. Magnitude of the stress gradient in a torsion member depends on the stress and the size of the member and for elastic stresses is equal to—

$$\frac{\sigma}{r}$$

where r is the radius of the cross-section of the specimen. If the measured strength of a material is influenced by the stress gradient, then results may be obtained from the tension test differing from those of the torsion test.

Tension Test Results

The tension tests were performed at three different head speeds ranging from 0.021 to 0.32-in. per minute. During the

*l/r refers to ratio of length of specimen to radius of gyration of cross section of specimen

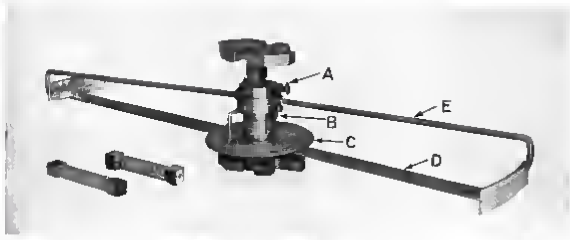


Fig 4 Instrument for measuring shearing strain (in torsion tests) consisted of two rings A slipped over specimen and fastened to it by three adjusting screws in each ring. A gage length of 2 in. was obtained by use of removable spacer B. To one of rings was fastened of circular scale C for measuring large angles of twist. Two 10-in. arms D fastened to same ring carried scales on end, which were used in measuring small shearing strains. Adjustable pointers E were attached to other ring in such a way as to indicate readings on their respective scales.

tests, readings of load deformation and time were taken. From these readings the values of stress and strain were computed using the original cross-sectional area for computation of stress.

Fig. 5 shows the tensile stress plotted against tensile strain for these three tests. It is evident that the higher rates of strain produced higher values of stress in the region beyond the proportional limit. The diagrams plotted to an enlarged strain scale (Fig. 5) indicated that the modulus of elasticity was the same for all three rates of strain. Herein the modulus of elasticity is designated as the ratio of stress to strain at the initial portion of the curve and is measured as the slope of the initial straight line portion of the curve.

The value obtained in the tension test was 244,000 psi. The upper yield point was designated as the stress corresponding to position *A*, Fig. 5. The upper yield point varied from about 3,500 psi. at a rate of strain of 0.0016 per min. to 4,400 psi. for a rate of strain of 0.04 per minute. The lower yield point *B*, Fig. 5, ranged from 3,200 to 3,800 psi. and the fracture stress ranged from 4,500 to 5,500 psi. for the same rates of strain given above.

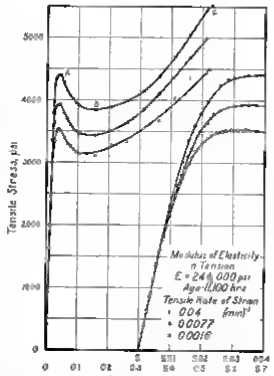


Fig. 5. Static stress vs. strain in three tension compression tests.

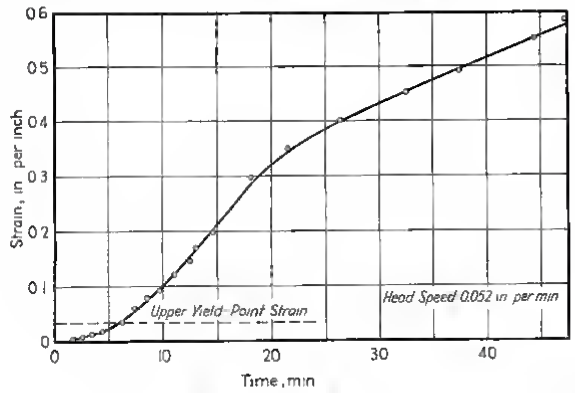


Fig. 6. Strain vs. time in tension.

Rate of strain for these tests was determined from strain vs. time curves such as shown in Fig. 6, and was computed from the slope of the strain-time curve in the portion of the curve corresponding to the linear portion of the stress-strain curve. It was noticed that the rate of strain was not constant but consisted of three fairly distinct but separate straight lines. This change in the rate of strain during a test was due in part to the elasticity of the testing machine.

Compressive Test Results

Compression tests were run at head speeds from 0.008 to 0.13 in. per minute. During each test readings of load deformation and time were taken. From these data the stress and strain were computed using, as before, the original cross-sectional area in computing the stress. The stress was plotted against the strain in Fig. 7 for three compression tests at rates of strain approximately the same as those used in the tension test. It was observed in these tests that the modulus of elasticity, as defined above, was not the same for all rates of strain but increased from 204,000 psi., at the lowest rate of strain, to a value of 278,000 psi. at the higher rate of strain, which was about ten times as fast as the first rate of strain.

The yield point observed in these tests increased with the rate of strain from a value of 3,400 to 4,300 psi. Rate of strain for the compression tests was determined from strain time diagrams similar to that shown in Fig. 6, and the rate of strain was determined in the same way. The strain-time diagrams for compression tests were similar to those for tension, except that the test data were not obtained much beyond the yield point.

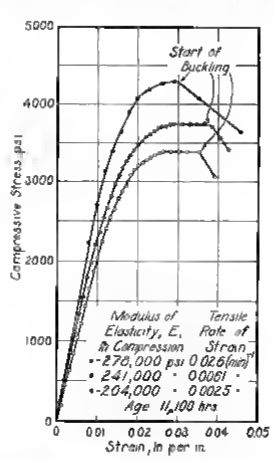


Fig. 7. Static stress vs. strain in three compression tests.

Torsion Test Results

Torsion tests were performed at three different head speeds, ranging from 0.017 to 0.33 rpm. During these tests, simultaneous readings of torque, angle of twist, and time were taken. The shearing stress at the surface of the cylindrical specimen was computed from the equation—

$$r = \frac{Te}{J}$$

and the shearing strain was computed from the relationship—

$$\delta = \frac{c\theta}{l}$$

It is recognized that the equation used for Δ does not give the actual stress, except for stresses below the proportional limit. However, for comparison of the relative strength of the material under different conditions the equation is sufficiently exact. Shearing stress, as discussed above, plotted against the shearing strain is shown in Fig. 8 for three different rates of strain. Shearing modulus of elasticity, found to be the same for all three rates of strain, had a value of 78,300 psi. Values of shearing stress increased with the rate of strain, just as observed in the tension and compression tests.

The upper yield point *A*, Fig. 8, increased from about 2,600 to 3,300 psi., with increase in rate of strain; the lower yield point increased from about 2,500 to 3,000 psi.; and the torsional modulus of rupture increased from 4,300 to 4,900 psi. Rates of strain were determined from strain-time diagrams, such as shown for tension tests in Fig. 6, and were computed from the slope of the curve which obtained during the linear portion of the stress-strain curve.

In order to compare values of shearing strength with values of tensile and compressive strength, equivalent rates of strain were used for all tests. In order to accomplish this, the rate of tensile strain was kept the same for all three types of test. The maximum tensile stress occurring in a torsion member is equal to the maximum shearing stress so that the tensile rate of strain can be computed from the shearing rate of strain by the relation—

$$\frac{\epsilon}{t} = \frac{\delta}{t}\frac{G}{E}$$

where ϵ/t is the tensile rate of strain, Δ/t is the shearing rate of strain and G/E is the ratio of shearing modulus to tensile modulus. It was decided to use equal tensile rates of strain rather than equal shear rates of strain because the material fractured along planes of maximum tensile stress under the conditions of loading studied.

Comparison of Test Results

A comparison of the results of the three different tests shows that the upper yield points in tension and compression (long specimen) were approximately the same. However, the yield point obtained with the short compression specimen was about 40 percent higher than the upper yield point in tension. The upper yield point in torsion was about ¾ of that tension. In the compression test, no difference was observed between upper and lower yield points. The difference between upper and lower yield points in torsion was much less than that in tension. The total strain required to rupture a specimen in torsion was 50 percent greater than that required to rupture a tensile member, whereas for compression, rupture did not occur at all for very large strains.

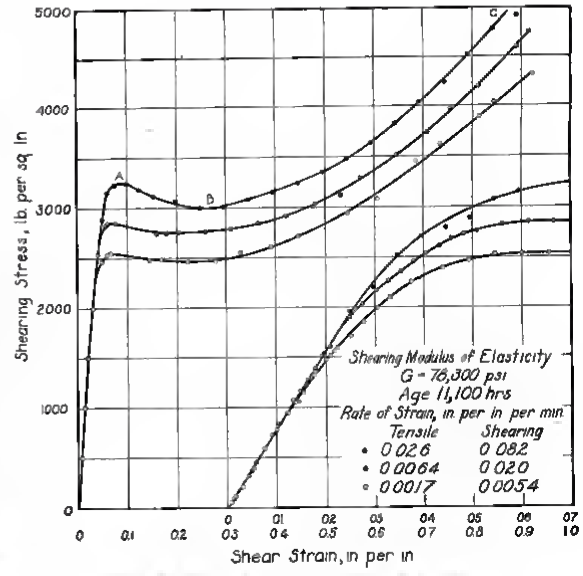


Fig. 8. Static shearing stress vs. shearing strain in torsion.

A considerable ductility of material was shown in all tests as evidenced by maximum strains of the order of 40 to 50 percent in tension. However, the fractures were those characteristic of brittle material, as usually thought of from the standpoint of metals. That is, fracture occurred as a result of separation along the plane of maximum tensile stress, a plane perpendicular to the axis of the

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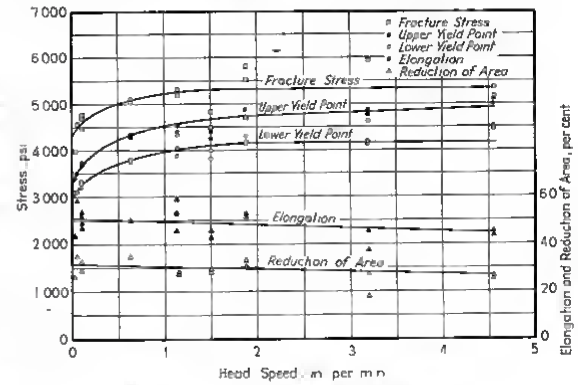

Fig. 9. Effect of speed of testing on tensile properties.

Design Craftsmanship Cuts Engine Production Costs

By H. S. GOLDEN, *Asst Chief Engineer, Buick Motors, General Motors Corp.*

Detailing manufacturing strategems by which Buick has outflanked those twin enemies of the engineer — high costs and service troubles.

ARRANGEMENTS between the Buick Motor Div., General Motors Corp., and the Pratt & Whitney Div., United Aircraft Corp., specified that no design changes were to be made in the P & W engine that Buick builds.

However, experience gained by Buick in the production of this engine led to certain seemingly minor design changes agreed to by P & W engineers that have had a marked effect—either in reducing production costs, in avoiding service troubles, or both. Several such instances are outlined in this article.

Fins of the cylinder head around the sparkplug opening were giving trouble from breakage at critical speeds, the vibration causing this breakage being set up by air currents passing between the fins. To overcome this difficulty, the contour of the fins was altered to decrease length and the sectional area (thickness) was slightly increased near the base of the fins where fillets are joined and meet the body of the casting (as shown in Fig. 1). This changed the critical period and eliminated breakage without altering performance in other respects.

Furthermore, specifications formerly required that intake pipes, which include a 90-deg. elbow, should be formed from seamless steel tubing. When the supply of such tubing became greatly restricted Buick secured permission to employ a welded seam tube (as shown in Fig. 2). This is made on a continuous resistance-type electric seam welding machine formerly employed by Buick in making exhaust tubing for passenger cars. The welded tubing is cut to length and bent in a special machine. Subsequently, the elbows are sized inside by clamping in a die while steel balls are forced through by the ram of a press. Weld flash is completely removed. This method of manufacture has considerably reduced costs, besides avoiding a critical material shortage, and it has had no adverse effect upon engine performance.

The fuel pump coupling was changed from the two-piece design shown in Fig. 3 (where the parts were joined by soldering) to a one-piece design (Fig. 4) in which, of course, no soldered joint is needed. It was formerly thought that a part such as that in Fig. 4 would be impractical to manufacture, but Buick developed a new manufacturing technique by which it is produced as shown. This results in a part that cannot give the trouble from leakage, sometimes encountered before.

Reduction drive gear couplings and mating nuts formerly had right-hand threads. Failure of both the bearing gear and other gears in the nose section had resulted because the nut had sometimes loosened and backed off. Such failures have now been eliminated by changing to a left-hand thread in which the tendency is for the nut to tighten rather than to come loose. Fig. 5 shows the coupling and nut in their present form with left-hand threads.

Variations in the choke dimensions at the end of cylinder bores were considerable when this portion was ground before the cylinder head was screwed and shrunk on. Now, the grinding is done after the heated head is screwed on, and the head shrinks to the barrel. As a result, variations are only slight, and the amount of honing required is greatly reduced, lowering costs accordingly (Fig. 6).

Formerly, oil control rings on pistons were made with a radius at the lower portion of the outer diameter. It was not too easy to hold the specified radius and, when it was held, the width of the land or bearing surface left was 0.035 to 0.045 in. By changing the radius to a chamfer made at an 18-deg. angle (as shown in Fig. 7) the land width is decreased to hold the limits 0.025-0.035 in. This narrower land results in increasing the unit pressure of the ring against the wall of the cylinder and enables the

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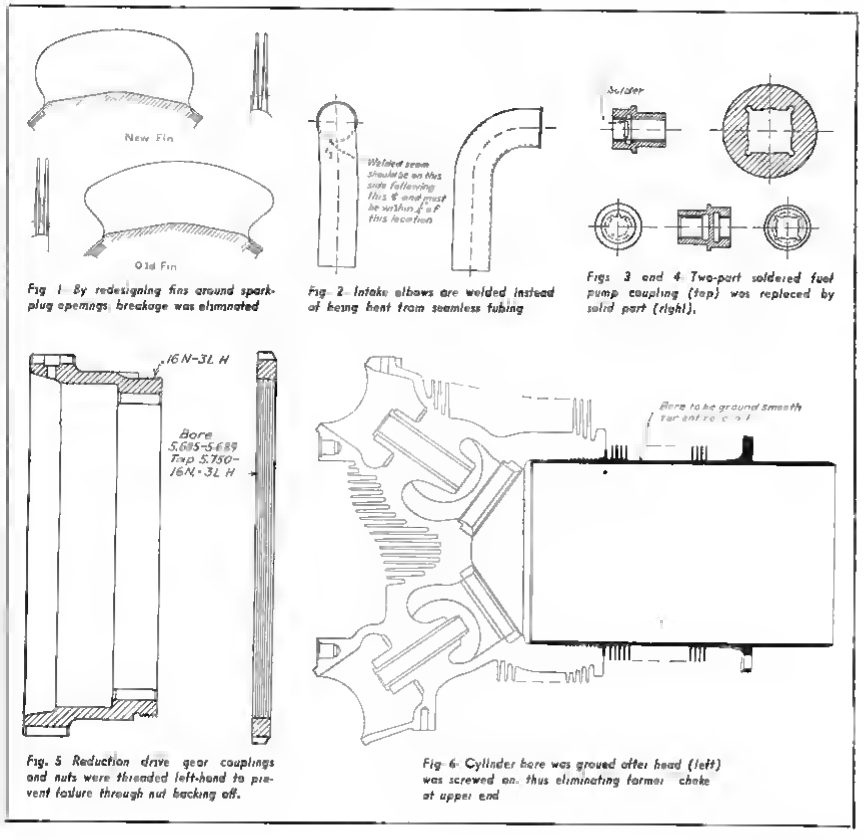


Fig. 1. By redesigning fins around sparkplug openings, breakage was eliminated.

Fig. 2. Intake elbows are welded instead of being bent from seamless tubing.

Figs. 3 and 4. Two-part soldered fuel pump coupling (top) was replaced by solid part (right).

Fig. 5. Reduction drive gear couplings and nuts were threaded left-hand to prevent failure through nut backing off.

Fig. 6. Cylinder bore was ground after head (left) was screwed on, thus eliminating former choke at upper end.

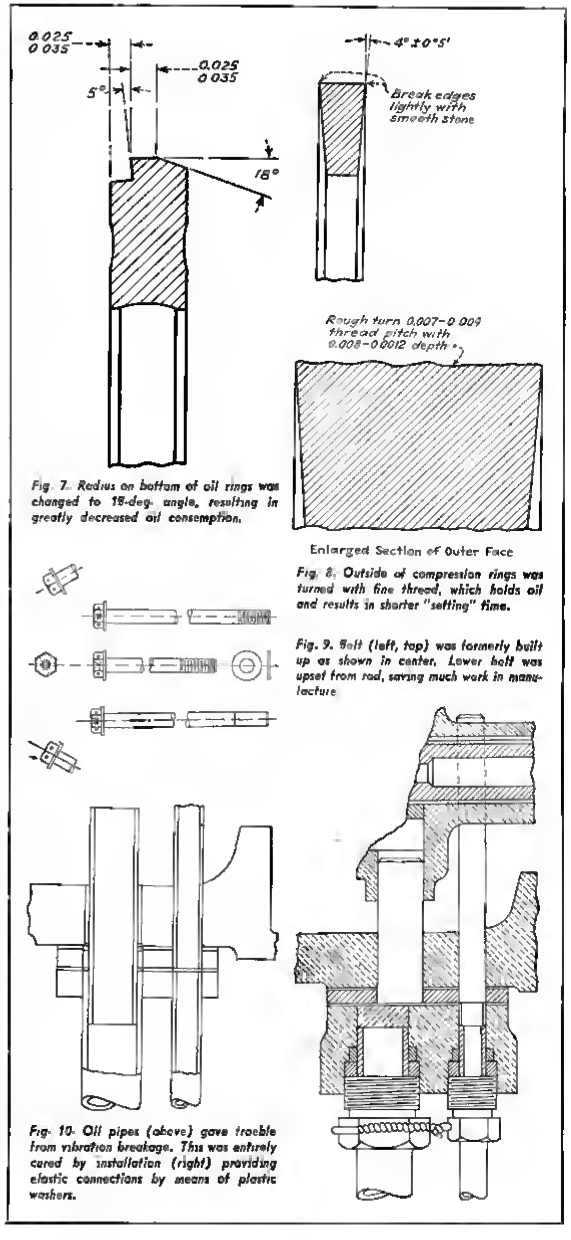


Fig. 7. Radius on bottom of oil rings was changed to 18-deg. angle, resulting in greatly decreased oil consumption.

Fig. 8. Outside of compression rings was turned with fine thread, which holds oil and results in shorter "seating" time.

Fig. 9. Bolt (left, top) was formerly built up as shown in center. Lower bolt was upset from rod, saving much work in manufacture.

Fig. 10. Oil pipes (above) gave trouble from vibration breakage. This was entirely cured by installation (right) providing elastic connections by means of plastic washers.

Convair Machine Sorts 50,000 Rivets Hourly

When this ingenious duol-feed mixed-rivet unit wos developed of Consolidoted's Noshville plont, there come the quick order: "Put it right to worh." Figure for yourself the sovings it affords in every-doy-of-the-yeor operotion ond you'll see why.

A NOVEL AND HIGHLY EFFICIENT machine for sorting mixed rivets has been developed at the Nashville Div of Consolidated Vultee Aircraft Corp Creator of the device is Harold O Mills, who first made an extensive study of the problem

This new dual-feed rivet unit will handle two different diameters simultaneously sorting them in the complete range of lengths at high speed. It is estimated that each hopper will feed 25 000 rivets per hour, making a total sorting capacity of 50,000 rivets per hour. A single ¼ hp motor drives the complete assembly, and it is to be noted that no air pressure is used

Details of the mechanism are revealed in our accompanying plate of cutaway sketches. Referring first to Fig 1, the two feed hoppers (1) are mounted at the back of the machine one on each side of the conveyor assembly (2) and at sufficient elevation to provide the necessary incline to the delivery channels (3) so that the rivets will slide by gravity from the hoppers through these channels and into the notches (4) on the conveyor plates (5)

Within each feed hopper is a rotating conical segment (6) which is provided with radial feed slots (7) of sufficient width to allow a free sliding fit for the shank diameters of the rivets but not wide enough to permit the head diameters to enter

The flexible agitator rod (8) extends from the support bracket (9) downward toward the segment (6) and near the stationary baffle rim (10) of the hopper Enough clearance is allowed between the lower end of this agitator (8) and the surface of the segment (6) to permit the heads of the rivets (11) sliding down the segment slots (7) to pass under the agitator.

As the segment revolves, the mass of loose rivets (12) collides with the agitator (8) thus the rivets are prevented from riding undisturbed. The vibratory resistance of this agitator repeatedly disarranges the mass of rivets as it is carried past it by the revolving segment, and as the rivets are thus shifted in position a number of the shanks will drop into the slots of the segment

Since the shank of a rivet is heavier than its head, and since the segment slots are not as wide as the head diameters, the rivets fall into the slots until supported by their heads, with the heavier shanks hanging downward. In this manner they slide down the inclined segment slots and underneath the baffle rim (10) until they are arrested by contact with the inner wall of the hopper base.

Now note the enlarged detail of the hopper mechanism in Fig 2. It is seen that the baffle rim (10) encircles the segment (6) and its attached by its outer circumference to the inner wall of the hopper base (13) The surface of this rim is wide enough to cover the lower portion of the segment, as shown, and it is located parallel to the slanted plane of the segment with enough clearance between for the thickness of the rivet heads to pass under. After the rivets (suspended by their heads in the segment slots) slide under this rim they are entirely freed from further interruption by the remaining mass of rivets, the weight of which is supported by the rim.

When the rivets become lodged crosswise (14) before sliding under the baffle ring the wedge-shaped extension (15) the upper edge of the baffle ring causes them to thrust upward from the path of their circular travel, and this disturbs them sufficiently to unclog the segment slot.

After they move down the segment slot until their heads (16) come in contact with the inner wall of the base rim (17) they continue in contact with this rim until the slot in which they ride carries them around to the delivery channel entrance (18)

At this point the space between the segment and the base rim gradually widens until there is clearance enough for a rivet (19) to leave the segment slot (17) and enter the delivery channel (20). This channel extends downward (lower portion, Fig 2) into a plane parallel to the horizontal operating plane of the conveyor plates and near enough to the edge of these moving plates (21) to guide the rivets from the channel into the conveyor slots (22), where they are thrust snugly into position by the spring (23).

Should a rivet arrive at this point out of time with the slot, the spring (23) will yield until another slot comes into position to receive the rivet.

Returning to Fig 1: On each side of the conveyor assembly (2) and parallel to its plane of movement is mounted a drive shaft (24) equipped with disks (25) of various diameters The shaft is so located that its center line of revolution is below and parallel to the line of travel followed by the rivet shanks (26) which extend downward from the conveyor plate notches (22) in which the rivets are carried by their heads

The difference in the diameters of the various disks (25 25-A, etc.) corresponds with the difference in the lengths of the rivets, so that the distance from the outer rim of each disk to the conveyor plates is just sufficient to permit one particular length of rivet to contact that particular disk.

Since the upper surfaces of these rapidly revolving disks move at right angles (27) to the parallel plane in which the conveyor plates travel, the direction of thrust transmitted to a rivet by contact with a disk is outward from the notch in which the rivet hangs from the conveyor plate.

Therefore, as the rivet shank (28) comes in contact with the disk (25) it is thrust forward out of the notch and into the delivery chute (29) A size-shorter rivet (30) would pass over the disk (25) but would contact the next disk (25-A) and thus be delivered into a different chute

In Fig 3, which depicts a cross section of the belt and carrying plates, the conveyor plates (31) are attached to the support bars (32) which are fastened to a V-belt (33) by two bolts (34). One of these bolts is provided with a slide mounting (35) to allow for the flexing movement of the belt.

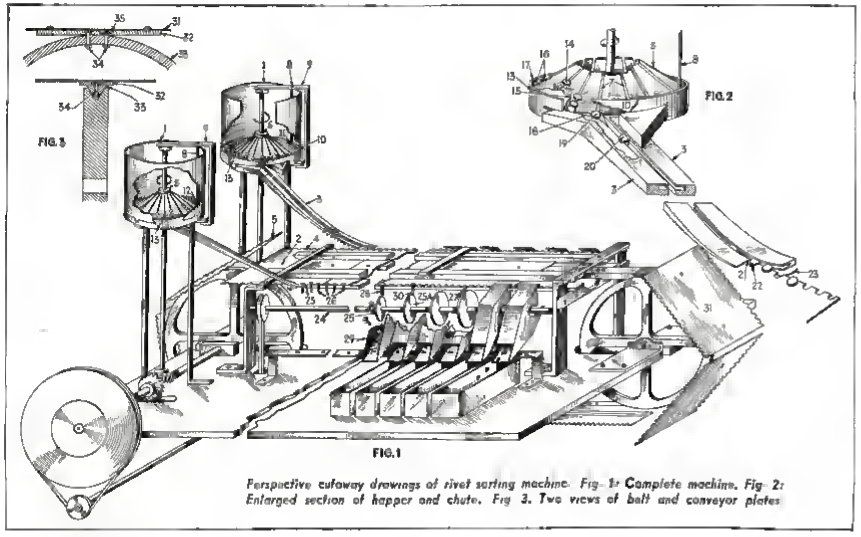
This diameter rivet sorter is of the gravity-feed, cradle-action type and consists of the following major units:

Feed hopper. This is a part of the rocking unit and is provided with a short agitator lever just behind the feed slot through which the rivets slide into the cradle trough for separation This agitator keeps the rivets from clogging by wiping in an arc across the floor of the hopper near the feed slot It is connected by a shaft through the hopper floor to a parallel pendulum, which conveys motion to the agitator from the rocking action of the machine.

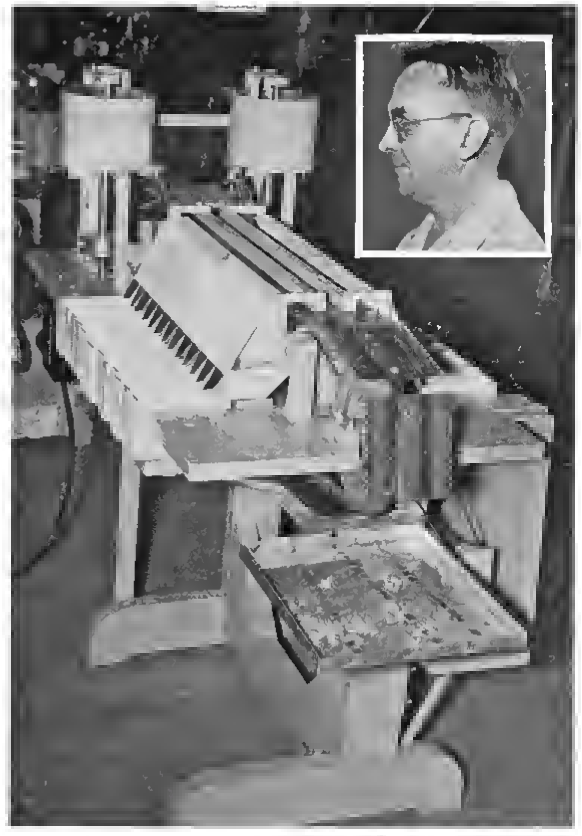
Cradle trough This trough is attached to a center shaft which is mounted to slant, at an angle of 10 deg from the hopper end down to the delivery end. An oscillatory drive mechanism causes this shaft to rock the trough sidewise in a 45-deg movement Rivets fed from the hopper are then shifted from side to side as they travel down the length of the trough to the end

Separator combs The bottom of the trough is divided into five sections each of which has a bottom plate of equally spaced transverse slots mounted in the center and extending to the sides of the trough, like the teeth of a comb. The width of these slots is varied in each of the five sections to correspond to the

(*Turn to page* 296)



Perspective cutaway drawings of rivet sorting machine. Fig 1: Complete machine. Fig 2: Enlarged section of hopper and chute. Fig 3. Two views of belt and conveyor plates



Fast-action rivet sorter set up in plant. Hoppers are seen in rear, sorting mechanism and bins in center, and reject pan in foreground Inset: H. O 'Bud' Mills, inventor of the device

METHODS FOR FORMING SHEET ALUMINUM

PART II—SPINNING OF ALUMINUM

Specific examples showing ways of forming circular aircraft parts without resorting to the expense of dies or heavy drop presses.

Method of spinning sheet aluminum with hickory stick.

THE art of sheet metal spinning was developed by a small group of artisans in Europe and introduced in the United States about 1840 by a man named Jordan who started a small shop in New York City. Through the years, the spinning of aluminum found most of its applications in the production of circular hollow shapes which could not be drawn because of design, or production where tool costs had to be kept low.

Today, spinning is largely an operation supplementary to drawing, in which the shell is first drawn and then necked by spinning.

In the spinning process, a lathe is used to rotate a metal blank at high speed while it is pressed against a rotating chuck of the form of which the blank is to take. The blank is forced against the chuck by means of tools, either manually or mechanically manipulated.

Spinning has advantages over some of the other forming processes in that the operator can feel the metal "flow" beneath the spinning tool. Tearing and breaking seldom occur since the experienced operator is able to judge the rate at which the metal is hardening.

Spinning lathes are similar in many respects to the lathes used for woodworking, although they are of heavier build. A larger headstock is necessary because of the great pressure exerted on it, and the bed of the lathe should be long enough to accommodate a wide range of lengths for a blank of given diameter, unless only shallow shells are to be spun. The tailstock screw should have a coarse pitch to facilitate removal of the shell after spinning.

Commercially pure aluminum (known as 2S) and some of the more ductile aluminum alloys may be formed into quite complicated circular shapes by spinning. The other aluminum alloys are not spun as easily as 2S, although the aluminum manganese alloy, 3S, because of its higher yield strength, is employed in the fabrication of a large number of spun articles. Occasionally 52S and the heat-treated alloys are spun, but they must be annealed frequently or spun hot. Whenever possible the softer tempers should always be employed in order to compensate for the strain hardening that takes place while the metal is being worked.

When it becomes necessary to anneal the metal before completing the spinning operation, a torch may be played on the partially spun article while it is rotating in the lathe. A soft pine stick rubbed across the metal will leave a brown char mark when the annealing temperature has been reached.

Heating with a torch will not fully anneal the metal. If it is necessary to fully anneal, the work should be removed from the chuck and heated to a tem-

Left to right: Forming tool, trimmer, and beader.

Table I—Speeds for Spinning Aluminum Disks

Blank Dia. In.	Thickness of Metal In.	Temperature of Metal Deg. F	Lathe Speed- RPM-
36 to 72	3/16 to 3/8	400 Max	50 to 250
24 to 36	12 ga. to 3/16	Room	250 to 550
12 to 24	20 to 12 ga.	Room	400 to 700
Up to 12	20 to 16 ga.	Room	600 to 1 100

NEWEST ICE PROTECTION DEVELOPMENT...

the electrically heated propeller shoe

Any pilot who has ever run into icing conditions without propeller ice protection knows why it's so vital to safe flight. Without it, ice forms on the blades, causing loss of propeller thrust, unbalance, and excessive engine vibration. Then, too, there is the danger and annoyance caused by ice flying off in large chunks and hitting the windscreen or fuselage.

It has long been felt that a blade covering which could be heated would be an efficient method of protecting propellers against icing. This type of ice preventer would be particularly well suited for use on long-range military aircraft.

Years ago, B. F. Goodrich engineers began development work on this type of blade covering. Today, the electrically heated propeller shoe is a reality . . . and it has performed amazingly well.

This new ice protection device containing synthetic rubber fits over and is cemented to the propeller blades' leading edges. It covers the area of the leading edge, where icing usually occurs. Electrical current from a generator (which may be mounted on the hub) produces heat in the shoe material. A special construction of the shoe concentrates heat directly at the leading edge, where ice protection is most vital. Efficiency is promoted by electrical and heat insulation at the blade side of the shoe.

The surface of the shoe is smooth, and conforms to the contour of the blade when cemented on. Thus there are no irregularities to upset airflow. Because the shoe keeps ice from forming, maximum thrust is preserved—unbalance and excessive engine vibration are minimized. The shoe also provides a highly abrasion-resistant covering for the blade.

For more facts about this new electrically heated propeller shoe, write to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

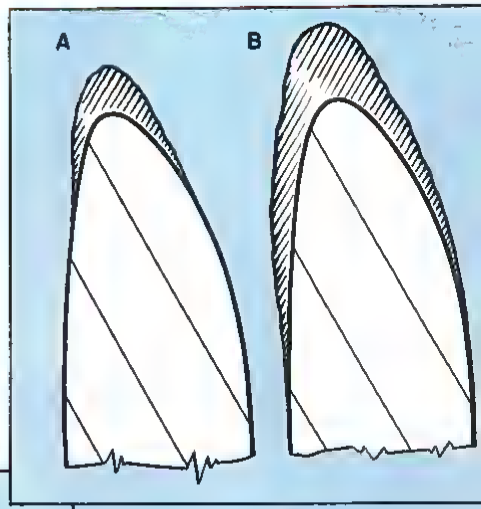
MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

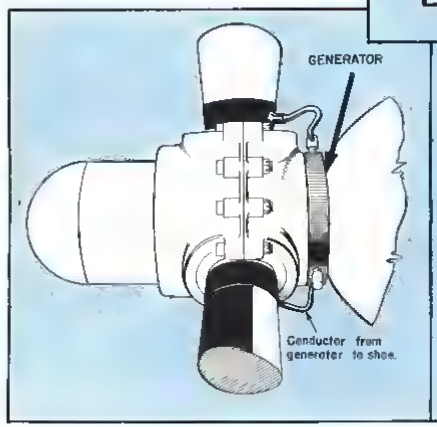
ARMY E NAVY
Awards to 9 plants

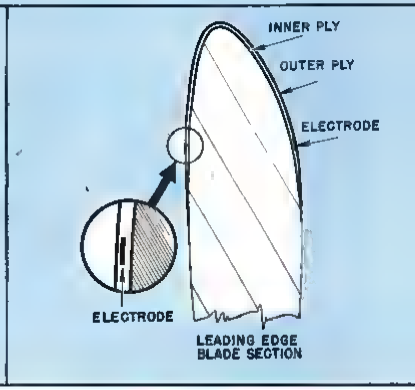
HEAT CONCENTRATION AT PROPELLER LEADING EDGE

increases efficiency at lowest temperatures

Scores of test flights led to the development of a means of concentrating heat across that part of a propeller blade's leading edge, where ice forms under severest flight conditions. In sketch A at right, is shown the way ice often forms under coldest temperatures. Note heavy concentration of ice at extreme edge. Sketch B indicates the greater area covered by ice under warmer conditions. This ice, being softer, melts at lower temperatures.







Simplicity keynotes the operation of the heated propeller shoe, as demonstrated in the sketch above. Note the location of the hub generator, which connects with electrodes in the shoe.

Cross section of a heated propeller shoe (right), showing the best concentration area and the insulation, which minimizes heat and current loss into the propeller blade.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

perature of 650 to 750 deg. Immersion in a molten nitrate bath at the above temperature is satisfactory for small articles. The time of heating will vary from 30 sec. to several minutes, depending on the metal thickness. In all cases, however, a fast method of heating should be used to prevent grain growth.

Lubrication of the blank during spinning is important because aluminum is quite easily marred in this process. Beeswax, tallow, and petroleum jelly are suitable for small pieces. When spinning large diameter blanks which require heavy tool pressure, the lubricants mentioned are not satisfactory because the forming tool cuts through and mars the metal. In such cases, ordinary yellow laundry soap will prove satisfactory to lessen friction and avoid scoring the metal.

There is no essential difference in the process used for making spun articles of aluminum and aluminum alloys from that used for copper and brass, except that higher speeds are employed. The peripheral speed employed in spinning aluminum depends not only on the blank diameter and the thickness but also upon the contour of the shell to be formed. It is usual practice to increase the speed of rotation as the diameter and thickness decrease. Lathes should have at least three speeds, such as approximately 1,200, 700, and 250 rpm. The lower speeds are used for large items and thick sheet. Table I gives the speeds for spinning blanks of various sizes.

The speed at which the lathe is operated may also be governed by the diameter of the chuck—the smaller the chuck, the greater the rotary speed. Speeds given in Table II have proved satisfactory, although each operator will have his preferences.

If the shell is of a design permitting direct withdrawal of the chuck, a one-piece chuck is employed, but if the shell partially encloses the chuck during spinning, sectional or off-center chucks are used. Sectional chucks are constructed so that by removing a key section the other pieces can be removed one at a time. These sections must fit perfectly at the joints, for the slightest irregularity will be impressed in the spinning.

The off-center chuck permits spinning over a solid form which comes in contact with the work only at the point of spinning and is small enough to pass through the

(*Turn to page 253*)

Spinning large shell by semi mechanical method, using two screws for feeding tool against work.

Table II—Speeds for Spinning Aluminum Shells

Mean Dia. of Shell In.	RPM
10–14	1 200–1 000
14–20	800– 550
20–30	550– 475
30–40	375– 325
40–50	300– 250
50–70	210– 200
70–90	175– 150

Tank end was first drawn, then spun on lathe.

Sectional chuck used if metal envelops it.

Off-center chuck used with small opening.

NEW SYSTEM SIMPLIFIES ENGINE CLEANING

By T. J. KEARNEY, *Technical Assistant to Vice-President Duntrex Corp.*

How former dirty and time-consuming job has now been streamlined, resulting in new efficiency in the aircraft overhaul plant.

CONTINUOUS EFFICIENT MAINTENANCE of the AAF is as precisely essential as was both the initial organization and construction phases—for once built, a military striking force must ever be kept in top shape for action.

Further, every good maintenance man quickly realizes that the system of "upkeep" is like the proverbial chain—only as strong as its weakest link. One of the "links" is the specific job of cleaning aircraft engines prior to complete overhaul, and it is an operation which has presented many new problems.

Necessity for complete yet rapid soil removal with a minimum of hand work is the major problem. This article will outline some of the important advances which, based on experience, are today producing most noteworthy results.

Disassembly of aircraft engines is handled in the usual manner. The entire engine is broken down into its component parts so that each may be cleaned and inspected prior to reassembly. Parts are placed directly on 42-in.sq. trays in subassembly groups. Four of these trays accommodate the major parts of a 9-cyl. radial engine, and a dolly should hold the four. These trays, full of work, are then placed in a vapor slush type solvent degreaser.

The solvent used is commercial stabilized trichlorethylene. For the cleaning of this work only the most highly stabilized type of degreasing solvent available should be used. Required physical properties of the solvent are listed in Table 1.

In degreasing, all parts of the engine are cleaned except pistons. The crankcase sections should be cleaned individually, this being necessary in order to drain completely these parts and to obtain total degreasing. Parts are left in the vapors of the solvent, then washed with a hand spray of clean solvent distillate generated by the degreasing equipment (see Figs. 1 and 2).

Use of the solvent degreasing cycle assures the removal of all oils and greases from the engine parts and allows no contamination of the work. All cleaning is accomplished by pure solvent vapors and clean distilled solvent. Work leaves the degreaser oil free, dry, and at a temperature of 188 deg. F.

The large parts which were cleaned individually should be replaced on work trays. The loaded dolly is then moved, by an overhead hoist, to the soaking tanks. These soak tanks are thermostatically controlled at 140 deg. F. Agitation is required for effective results, and a cleaning cycle of 30 min. has proved satisfactory. Mechanical agitation is recommended, since air agitation may cause excessive loss of solution strength. The soaking tanks are large enough to hold four fully loaded dollies at one time (see Fig. 3).

Table 1—Required Physical Properties Of the Solvent

Specific gravity	1.465 to 1.475 @ 15.5/15.5° C.
Moisture	Water content should be such that solvent may be cooled to −18° C. and allowed to come to room temperature without cloud formation.
Non volatile matter	Not to exceed 0.03% by weight.
Alkalinity	Initial .048 to .072% by weight, calculated as $NaOH$.
Distillation	Middle 50%. Upon distillation not less than 50% of initial should show the following: Initial point of Min. 84.4° C., 95% or better should distill between 84.4 C.–90° C.

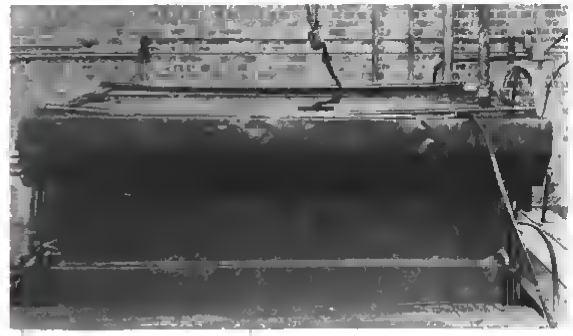


Fig. 1. Vapor slush degreaser for cleaning aircraft parts.

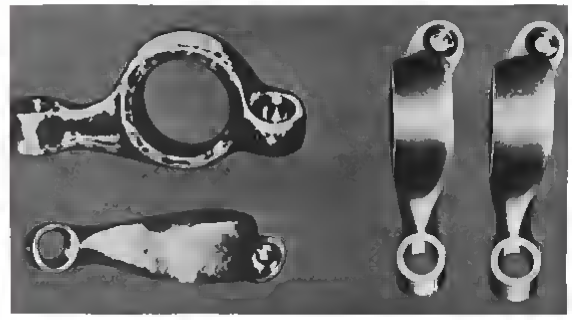


Fig. 2. Aircraft parts before and after cleaning.

Fig 3. Dolly of aircraft parts being lowered by electric hoist into soak tank.

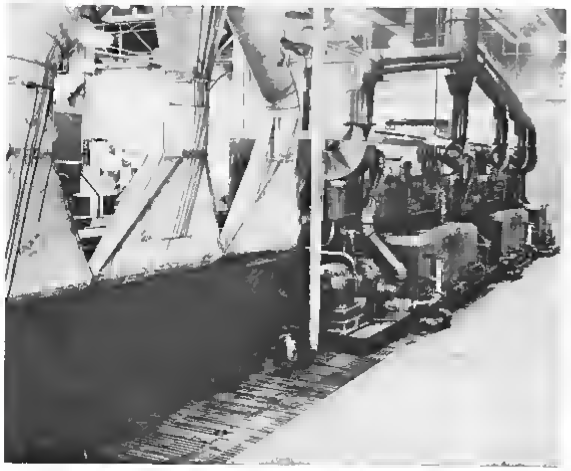


Fig. 4. Position of Dextrex washer (right) with respect to soak tank. (U.S.N. photo.)

The cleaning solution used is of the cresol type and should be employed with adequate local ventilation on each tank (see Fig. 4). This cresol base cleaning compound must have the general properties outlined in Table II.

After the work has been allowed to remain in the soak tanks, the trays are removed while still hot and are sent through the conveyorized washer. The overhead hoist raises the dolly out of the soak tank only long enough to slide the trays on to the gravity roll loading station of the washing machine.

Table II—Properties of Cresol-Base Cleaning Compound

(1 part compound and 4 parts distilled water)

Oil removing ability	Cleaning solution should be able to remove SAE #50 oil from anodized aluminum sheets in 15 min.
Paint stripping ability	Cleaning solution should be able to strip a panel with a zinc chromate primer and a black enamel glyceryl phthalate finish coat baked for 2 hr. at 360° F. without attack or oxidation of base metal.
Rinsing	Cleaned surfaces should show no sticky or iridescent film after reasonable rinsing in water.
Acidity	pH @ 20° C. shall be between 7.3 and 7.7.
Corrosiveness	Solution should not show any visible corrosive attack on polished steel, copper anodized aluminum, or magnesium alloy and not more than slight discoloration on polished aluminum alloys or cadmium plated steel after immersion.

Next, the work is carried through the washer on a slat conveyor (see Fig. 5). This type of conveyor presents a minimum of "shading" to the work being cleaned and allows for maximum drainage, thus eliminating carry-over of solution from one stage to another. The first stage consists of a high pressure spray (700 gpm. at a 50 ft. head) of a cresol type cleaner for 2 min.

From here the work moves to an inspection opening to permit crankcases and other similar pieces to be tilted by hand for drainage in order to eliminate excessive dragout.

Trays move from inspection into an emulsion cleaner spray. On emergence from this compartment into a second ventilated inspection position, the work is tilted to drain shallow cavities.

Passing through the final stage of the conveyorized washer, the parts are subjected to a thorough, hot-water, high-pressure spray rinse and are discharged onto the unloading platform. At this point, water can be blown off with compressed air. Since the parts are warm, they will dry readily and inspection for cleanliness can be made (see Figs. 6 and 7).

Any parts requiring hand operation for further cleaning can be segregated and routed to the hand cleaning booths; otherwise, the trays can be routed directly to inspection (see Fig. 8).

The washer is provided with curtains at the entrance and exit ends as well as baffles at the spray chamber in order to separate entirely the operations and solutions of the several stages.

Special features are incorporated in the wash stage to combat the foaming tendencies of the cresol type cleaning compound, and the charging boxes are provided with hinged water tight covers. Solid jet-type nozzles are used to keep the foaming and atomization of the cleaning compound to a minimum.

The washer is provided with start-stop controls at the load and unload stations as well as safety stop stations at each inspection and draining opening.

Pistons are cleaned by placing them in pressure cleaning tanks and by blasting with bird seed. Another successful method for cleaning pistons is solvent vapor degreasing to remove all traces of oil and grease, followed by high pressure blasting with wheat or plastic particles. The wheat is chopped, dehydrated wheat giving a particle size about twice that of

Table III—Properties of Specified Emulsion

Color	Amber
Boiling point	208° F
Specific gravity	.940 @ 25° C
pH (electrometric)	11.5
Flash point	150° F. open cup
Freezing point	16° F.
Weight per gallon	7.9 #/Gal.

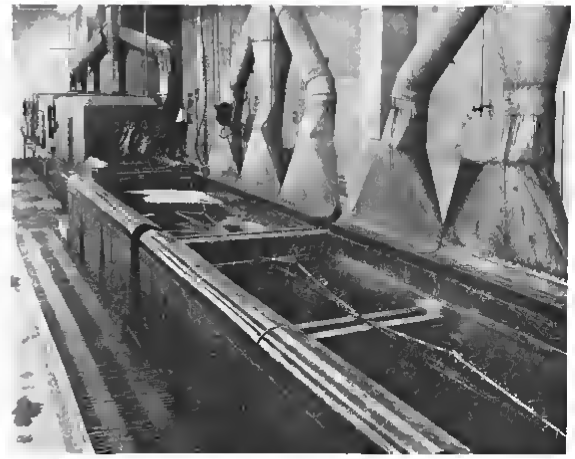
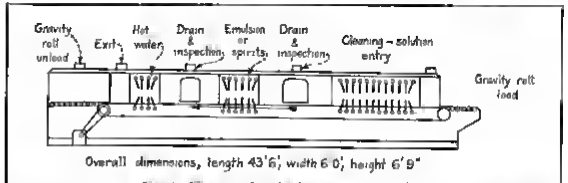


Fig 5. Soak tanks and Dextrex washer from operating side. (U.S.N. photo.)



Overall dimensions, length 43'6", width 6'0", height 6'9"

Fig. 6 Diagram of multiple stage spray washer.

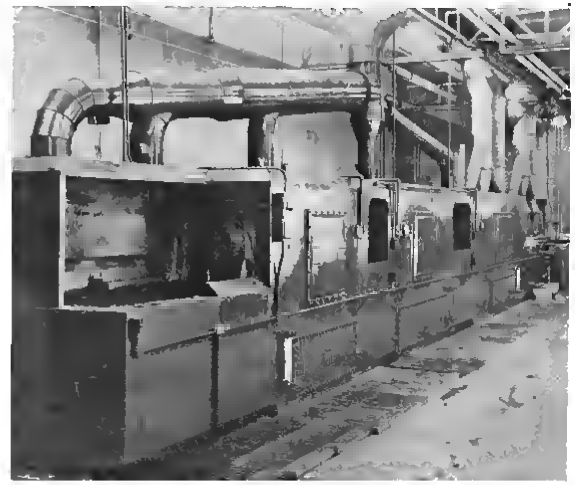


Fig 7. Washer used on aircraft parts. (U.S.N. photo.)

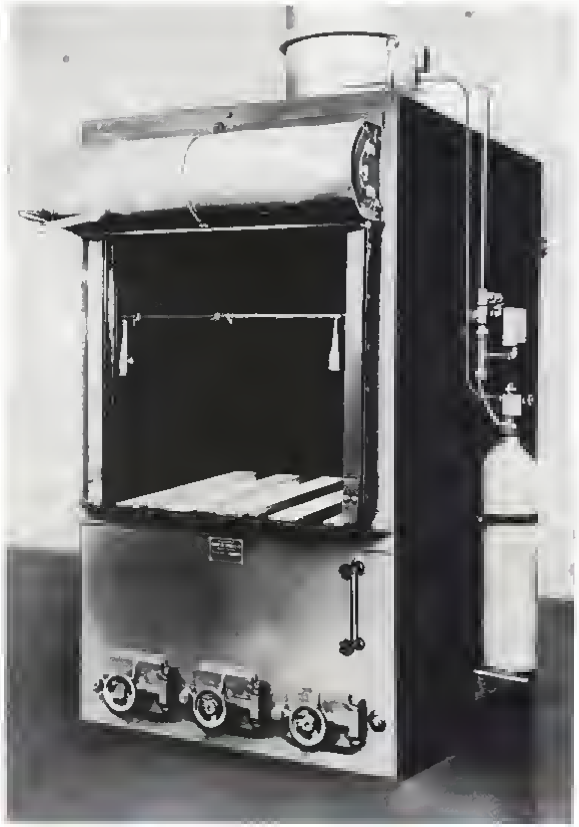


Fig. 8. Spray booth for cleaning small parts by hand

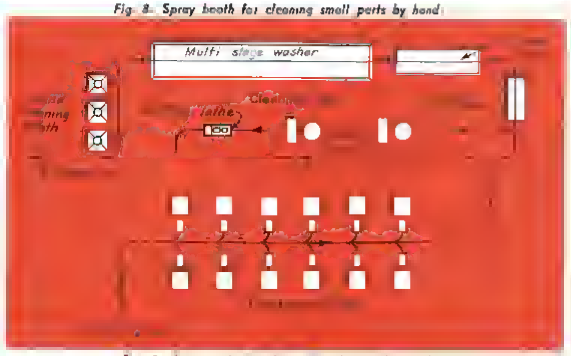


Fig. 9. Layout of aircraft engine disassembly and cleaning shop, showing sequence of operations

ordinary blasting sand. These materials, as effective and long-lasting as sand, do not damage the smoothly finished surfaces of the pistons.

Thereafter, the pistons are placed on the continuous washer at inspection opening preceding the soap spray. After they have received an emulsion spray and hot water rinse, they are further cleaned in hand-cleaning booths. The emulsion material mentioned has properties outlined in Table III.

If any carbon remains on the parts—it's often found on the upper end of the link rods—this can be removed by buffing, followed by a final cleaning operation in one of the hand booths to remove any traces of buffing compound.

Petroleum spirits cleaning. Referred to in connection with hand cleaning and shown in Fig. 8, this phase of metal cleaning commonly uses a petroleum fraction with a closed cup flash point ranging from 100 to 150 deg. F. These solvents, sold under various trade-names by the major distributors of petroleum products, fill a definite requirement in the metal cleaning field. They can be used when a high degree of cleanliness is not essential and if the only contamination consists of oil or grease.

Many delicate parts of assemblies which could not be allowed to come in contact with water and upon which a light oil film is desired can be cleaned only by this method which invariably leaves the surface slightly oily.

Petroleum solvents also answer the essential need to fill in cleaning parts which have been previously painted, also where other cleaning methods would have adverse effects upon the surfaces. These solvents are used without heat in one or two stages of immersion, often, too, in spray washing equipment with as many as three consecutive spray stages. Frequent replacement of solvent is necessary because the contamination of 2 percent by volume usually results in unsatisfactory cleaning results.

Contaminated solvent can be reclaimed by distillation in properly designed stills. These solvents are volatile and definitely constitute a fire hazard. They should be used only in equipment properly designed for their application.

Care must be taken in designing this equipment to eliminate possible sources of sparks, and adequate fire prevention equipment, such as a carbon dioxide system, should be incorporated.

With equipment outlined above, much labor and time is conserved, excellent and uniform results can be obtained, and only 1 percent of the dirt or carbon requires hand labor for removal. A 9 cyl. air cooled radial engine can be cleaned in less than 1½ hr. A similar cycle is adaptable for the cleaning liquid-cooled aircraft engines with very few changes required.

Because the large airlines are concentrating major overhaul at one location and in many cases are also performing overhaul work for the armed forces, a complete cleaning arrangement (as outlined in Fig. 9) may be desirable.

Operation and Servicing Of Zero-Lash Valve Lifter

THIS LIFTER consists of outer body *A*, having a straight, machined hole to receive hydraulic unit which comprises cylinder *B*, plunger *C*, ball check valve *D*, and plunger spring *K*. Oil under pressure from lubricating system is supplied through hole *H* to supply chamber *L*.

When lifter face is on cam circle and valve is seated, spring *K* lifts plunger *C* so that all clearance in valve train is taken up. As *C* moves outward, increasing volume of oil in *L* ball check, *D* moves off its seat and oil from *J* flows in and fills *L*.

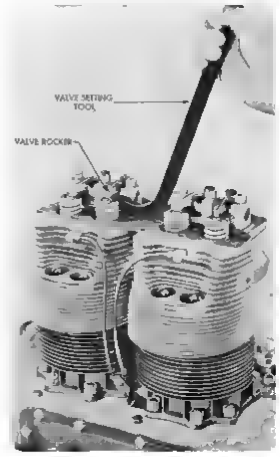
While camshaft rotates, cam pushes lifter body outward, tending to decrease volume of *L* and seating valve *D*. Further rotation of camshaft moves lifter body *A* outward and oil confined in *L* acts as a solid member of valve train, valve being lifted on a column of oil, which carries valve as long as it is off its seat. During this period a slight predetermined leakage takes place between plunger and cylinder to compensate for any expansion or contraction in valve train.

Immediately after valve closes, oil flows into *L* through *J* to provide correct column length for next cycle.

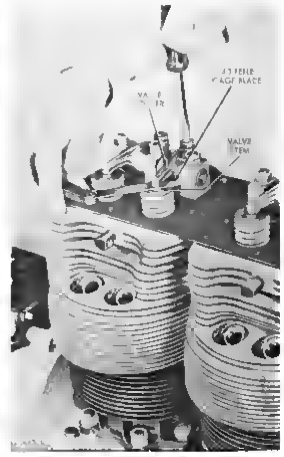
It is impossible for this lifter to hold valve open when it should be closed, since when *A* is on surface of cam and valve is closed, only pressure tending to open valve is that of light plunger spring *J*.

Proper clearance between valve rocker and stem is .040 in. with piston in firing position and all oil forced out of hydraulic lifter by pressing back on valve rocker with valve setting tool until no further clearance is obtained. If lifter fails to function, clearance between valve stem and valve rocker will be approximately 100 in., with danger of considerable damage being done to parts.

When adjusting screw on end of rocker arm, push rod should be held compressed so that required .040-in. measurement is made without there being any tendency to increase distance by springing rocker arm.

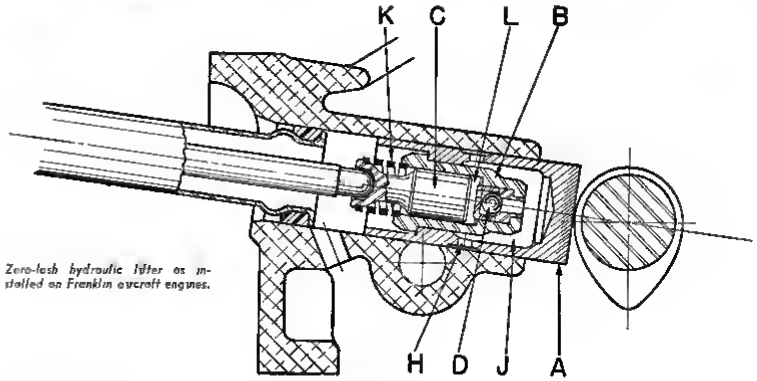


Method of forcing oil from lifter.



Making rocker adjustment.

(Aircooled Motors Photo)



Zero-lash hydraulic lifter as installed on Franklin aircraft engines.

STEPS IN SERVICING CHAMPION SPARKPLUGS

A graphic picture account of the methods recommended by the manufacturer for inspecting, cleaning and adjusting sparkplugs, including final testing steps prior to reinstallation.

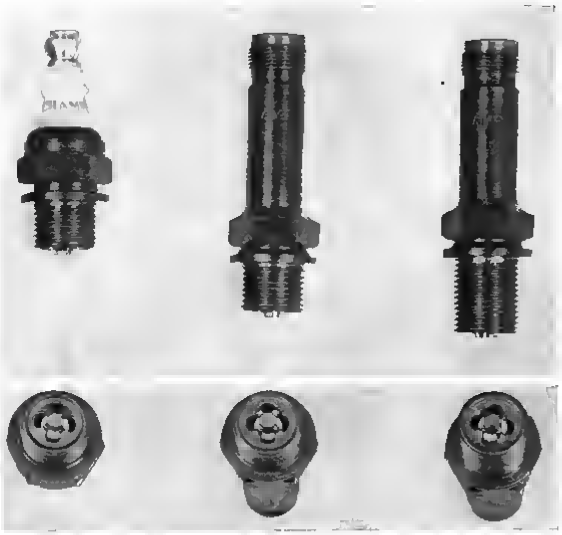
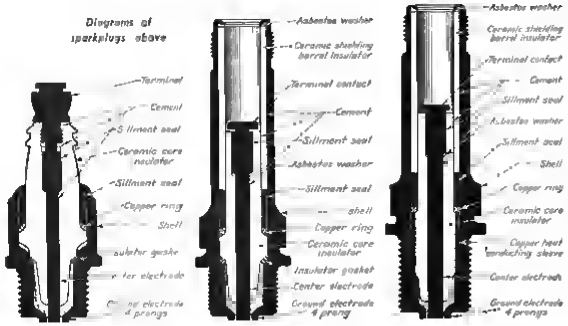


Fig. 1. Three types of aviation sparkplugs. Left: Unshielded. Center: Shielded, short thread. Right: Shielded, long thread. (All illustrations by Champion Spark Plug Co.)



TWO STEPS are primary in the servicing of sparkplugs—the cleaning and adjustment of the points. However, before launching any considerable amount of servicing, a sparkplug should be carefully inspected to locate, if possible, any damage which may have occurred either during use or handling, thus disabling the plug. For many sparkplugs which have been carefully serviced and adjusted before such inspection have been found unsatisfactory when tested later.

It is stated that cleaning of Champion electrodes is usually performed by soaking in Klenzol, care being taken to make sure that no liquid enters the well at the upper end of the plug. The lower end is then blown out and sandblasted, being rocked with a rotary motion over the blast. This step should not be prolonged to over 3 sec. or the electrodes may be damaged. The sand is then blown out and the ceramic shielding on the inside of the barrel is cleaned with the tool shown in Fig. 11a. alcohol should be used—never a chemical solvent, since the latter has a tendency to remain at the bottom of the cavity and cause trouble later. If alcohol alone will not clean the ceramic lining, a little Bon Ami may be used with it.

In employing the electrode-adjusting machine (Figs. 13 and 13a), the operator should carefully avoid damage to the center electrode caused by pressing against outer point when feeler gage is between the parts. The center electrode is made with a tungsten point which will not stand heavy side pressure, though it is entirely suitable for its regular work.

When completely cleaned, adjusted, and inspected, plugs should be stored carefully to prevent damage, preferably with plastic caps (shown in Fig. 19). Plugs returned to service should have a mica base lubricant in the threads.

In tightening sparkplugs in cylinder heads, a torque wrench should be used both to preserve the plugs and also to prevent damage to head bushings. Makers advise following torque: For 18-mm. plugs, max. 40 ft-lb. or 480 in-lb., for 14-mm. plugs, max. 30 ft-lb. or 360 in.-lb.

Gaps should be set as follows:

.012 Gap	.011 Go	.014 Nogo
.015 Gap	.014 Go	.016 Nogo
.019 Gap	.018 Go	.020 Nogo
.022 Gap	.020 Go	.024 Nogo

Pressure is applied 1/16 in. from ends

Fig. 2. Inspect points for burned prongs.

Fig. 3. A plug with end damaged (as above) should be rejected.

Fig. 4. Soak plugs in approved solvent, keeping ends above liquid.

Fig. 5. Blow off excess cleaning fluid, directing air downward.

Fig. 6. Next tilt plugs and dry lower ends with air pressure

Fig. 7. Inspect threads on both ends watching for bruises

Fig. 9. Sandblast for 3 sec.—revolving plug during operation.

Fig. 8. Check threads with gage and remove bruises with standard die

Fig. 10. Blow sand out of cavity in plug

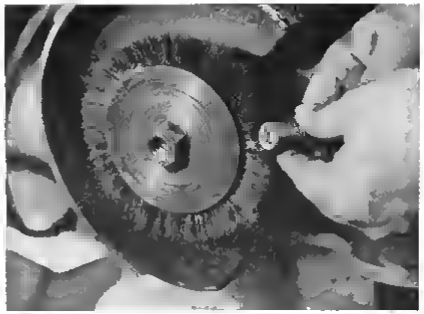


Fig. 11. Brush threads on .007-wire wheel, keeping wire out of plug end opening.

Fig. 11a. This tool, used with alcohol, cleans internal ceramic shielding.

Fig. 12. Chief Inspector B. L. Christman examines a sparkplug after cleaning. Instrument is twin-eyepiece microscope, fitted with spotlight.

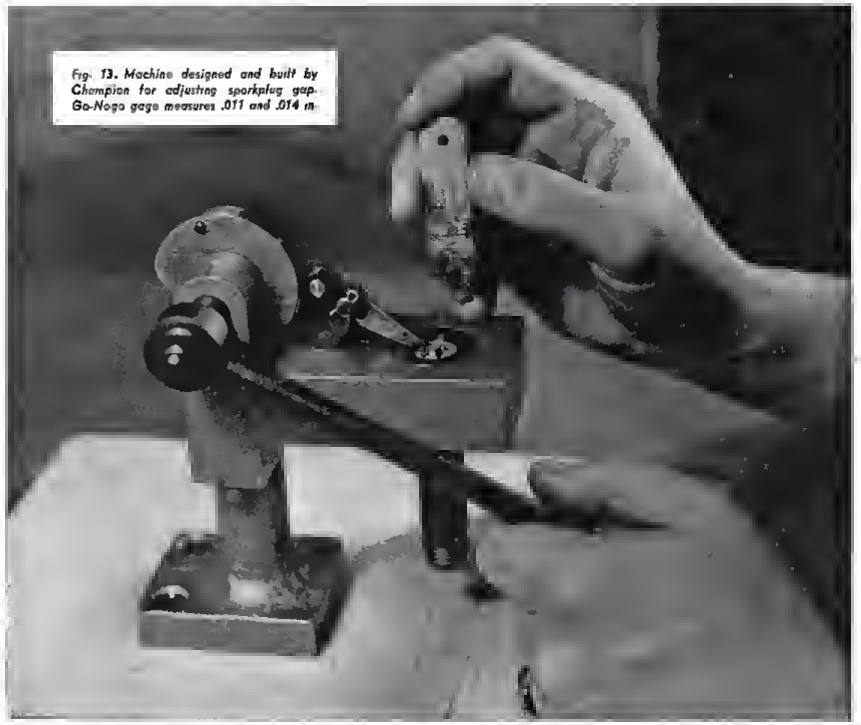


Fig. 13. Machine designed and built by Champion for adjusting sparkplug gap. Go-Nogo gage measures .011 and .014 in.

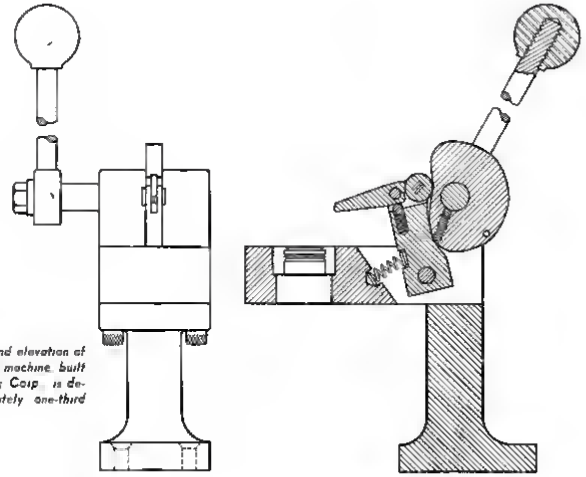
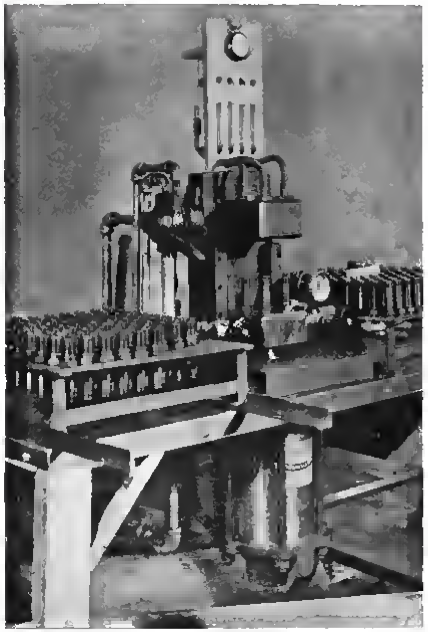
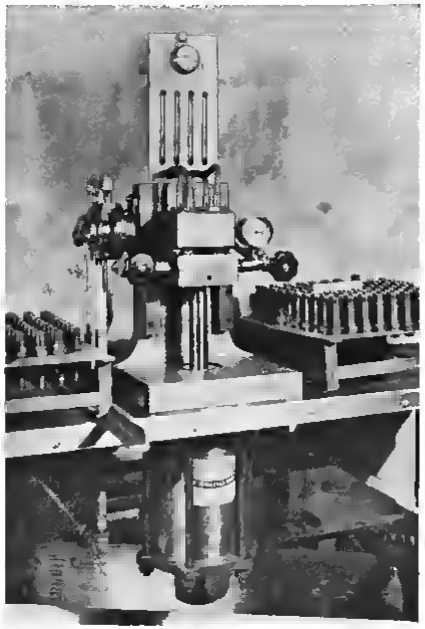


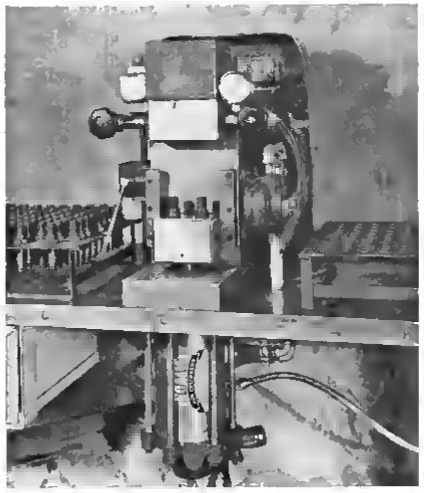
Fig. 13a. Section and end elevation of sparkplug gap adjusting machine built by Champion Sparkplug Corp. is depicted here approximately one-third size



Figs. 14 and 15. This machine tests plugs for leakage under 800 psi air pressure for 15 sec., leakage being restricted to .5 cc. and indicated in manometer tubes at top of board. Left: Machine open.



Right: Closed with plugs under pressure. Note pressure gage readings at right of machine, also varying manometer levels. Few plugs are absolutely tight.



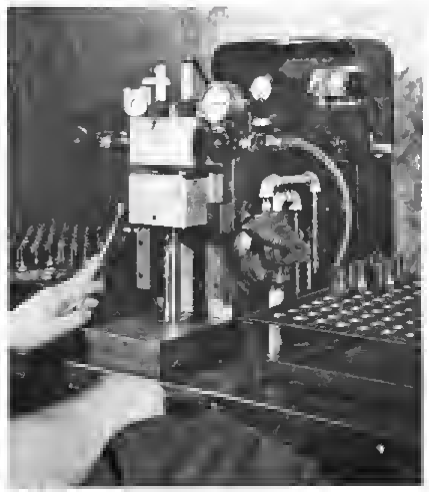


Fig. 16 and 17. Electrical test. Machine (open at left) shows plugs in position. When closed (right) gage indicates air pressure, while heavy spark—9,000 v.—jumps gap at upper right. Any short circuit in plug kills spark.

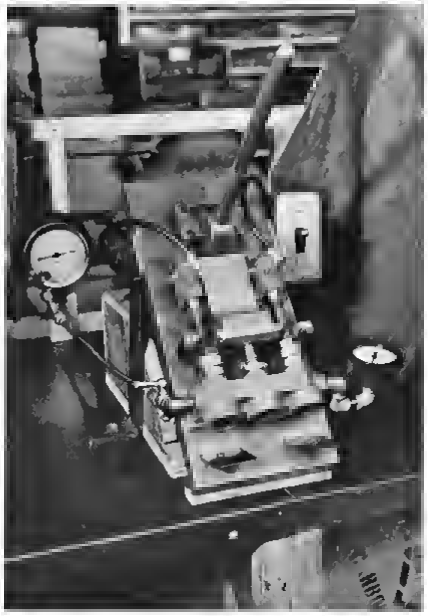


Fig. 18. Plugs are electrically tested in this machine. Sparks shine through glass bottoms of holders, and light is reflected from metal mirrors at bottom of board

Fig. 19. Sparkplug completely reconditioned and painted, is fitted with washer and plastic caps to protect ends from dirt and damage. Paint is quick drying type

Progressive Line Methods Expedite Engine Overhaul

By J. R. HORTON, *Vice-President Embry Riddle Co*

Adoption of new time-saving methods in engine overhaul enables depot to increase output many times.

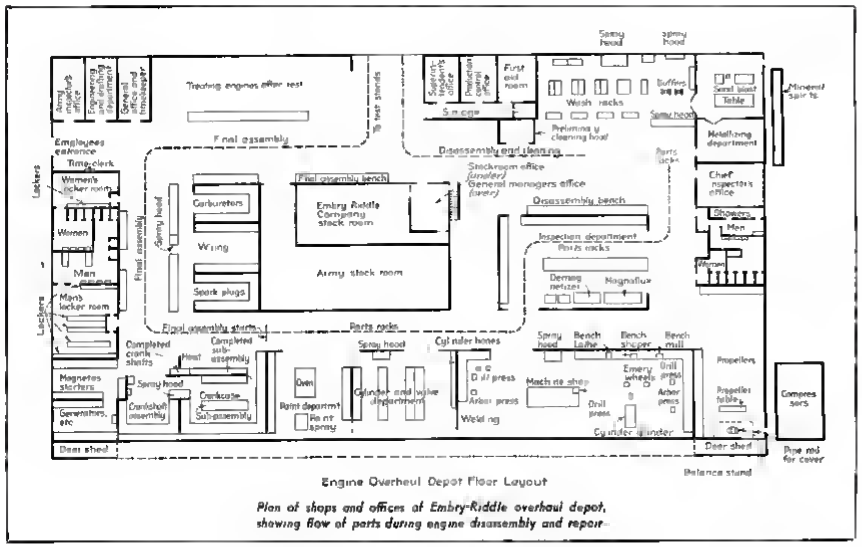
Valve spring compressor is used both in assembly and disassembly being operated by treadle This allows use of both hands and eliminates risk of injury

WORK ON the engine overhaul department of the aircraft and engine div. of the Embry-Riddle Co was started May 1, 1942, from grass roots. The period from May 1 to Aug 15, 1942, was spent manufacturing tools, fixtures, and other equipment, and in training personnel for the complete major overhaul of engines, propellers, and accessories

On Sept. 11, 1942 after a month spent in training and setting up shop, the first engine was overhauled, test run, and accepted by the Army. From that time to date the shop has completed major overhauls of more than 3,000 trainer engines, plus many additional accessories

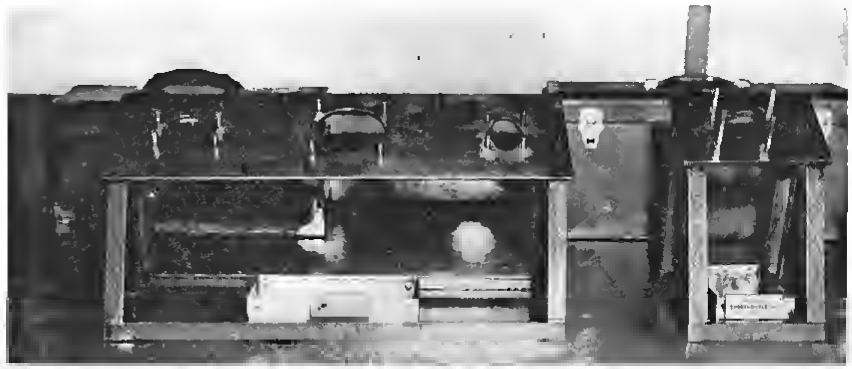
Engine overhaul is carried on in approximately 30 000 sq ft of floor surface. As tools and fixtures were practically unobtainable, or at least not obtainable for many months, these were designed and built by us. This enabled us to improve upon existing fixtures and to devise new ones resulting in accelerated production and decreased employee fatigue.

When received for overhaul engines are first uncrated and immediately placed in a pre-cleaning booth in which all preservative compounds, grit, and grime are removed Then engines are mounted on



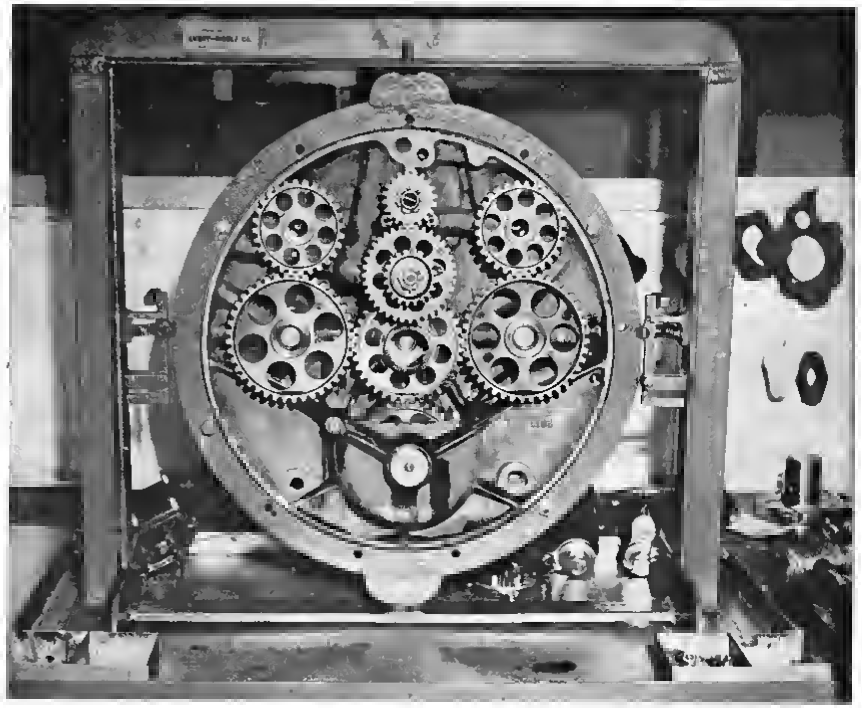
Engine Overhaul Depot Floor Layout

Plan of shops and offices at Embry-Riddle overhaul depot, showing flow of parts during engine disassembly and repair



Above: These oil pump and accessory drive fixtures are so designed that dowels hold the units securely, permitting them to be placed in position or removed without use of any other fastening.

Below: Rear case fixture used for disassembly and assembly. It will pivot and automatically lock with either front or back to mechanic, greatly increasing accessibility.



disassembly stand, of our design. Engines next travel through progressive disassembly, which is expedited by special fixtures and tools, also of our own design and manufacture.

All parts of the engine are placed, as disassembled, on rolling parts racks, each rack holding parts for one complete engine. Parts then pass through the cleaning department, each being thoroughly cleaned, polished, buffed, or sand-blasted, as may be required.

Next, parts pass into the inspection department, where each is either visually or magnetically inspected. Here, defective parts are rejected and new parts are requisitioned as necessary. Parts requiring rework are sent to the machine shop and rework department. After the necessary work has been completed, the parts are returned to the rolling rack. Racks then are moved through the various subassembly departments, first entering the cylinder department where cylinders are inspected, honed, or reground, as necessary. Valve seats are refaced or replaced and, after repainting or metalizing, each cylinder unit is assembled as far as is possible at this stage. During this same period, the oil pump, carburetor, gear case, magnetos, starter, and other components, are similarly reassembled and tested.

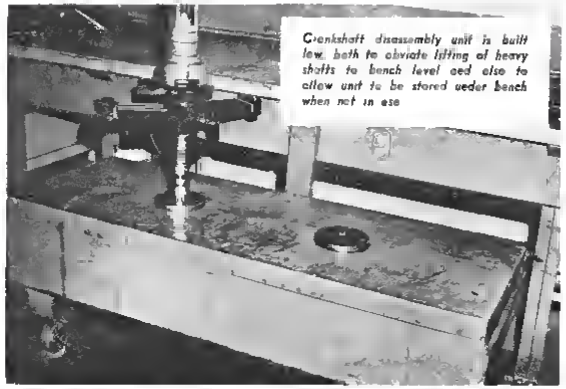
After inspection and refinishing, one section of the crankcase is mounted horizontally on the universal bedplate of a rolling assembly stand. The crankshaft assembly is then lowered, by means of a chain hoist, into its proper position in the crank case. Next, the other half of the crank case is added and the assembly continues along a progressive line to receive the cylinders, carburetor, starter, magnetos, and other accessories such as the wiring harness and spark plugs. The timing is checked and the engine is then routed to the test stands.

The engine is lifted directly from the final assembly stand and mounted on a universal bed plate on one side of our "shuttle jeep." This jeep has a chain hoist which lifts the engine to be tested so that it may be mounted on one side of the jeep carrier. Then the jeep goes to the test stands where it uses its hoist to dismount the engine previously tested and then mounts it on the opposite side of the carrier from the engine to be tested.

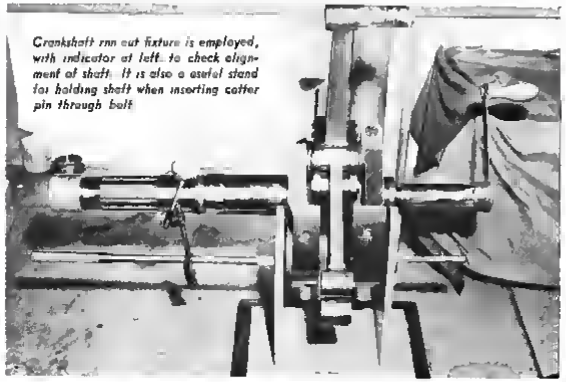
The engine for test is then lifted and mounted directly on the test stand. Here, the engine receives a fully calibrated test of several hours' duration. After completion of the tests, the jeep transports the engines to final inspection and treating department, where they are thoroughly checked, cleaned, and treated for storage.

Next, engines enter the shipping department, where they are encased in Pliofilm protective envelopes, from which all excess air and accompanying moisture is exhausted by means of a vacuum line. Final operation is placement of each engine in a box with shipping instructions.

All parts and work are, naturally, subject to extremely rigid inspection by both Army and company inspectors during all phases of the overhaul operation.



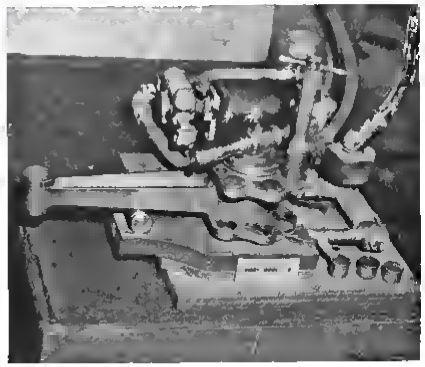
Crankshaft disassembly unit is built low, both to obviate lifting of heavy shafts to bench level and also to allow unit to be stored under bench when not in use.



Crankshaft run out fixture is employed, with indicator at left, to check alignment of shaft. It is also a useful stand for holding shaft when inserting cotter pin through bolt.

Sand-blasting cabinet with front door raised. Openings in door are to permit hands to be inserted without leakage of sand. Flaps at ends are to permit sand-blasting of long articles.

Standard belt sander is used to surface rocker box covers. By giving cover a half turn during operation, a smooth surface is obtained.



Master rod, crankshaft, and knuckle pin oil passages are cleaned by using this fixture which applies any required pressure up to 150 psi. Plugs shown are used to direct oil flow to passage being cleaned.

Cylinder-holding bench fixture enables operator to retain cylinder firmly in any position while grinding valves etc. Collet (right) is used to grasp valve stems while grinding.

Pistons are cleaned by this automatically centering chuck with use of an aluminum-covered steel pin to hold them in place. Blower above machine removes dust and dirt.

Operation and Adjustment Of Marvel-Schebler Carburetors

Herein, each part and action of the popular Model MA-3A is described, thee procedure for hot aed cold starts is detailed.

REFERRING TO accompanying detail drawings, when the throttle (28) is slightly open to permit idling, the suction above the throttle on the manifold side is very high. Very little air passes through the venturi (34) at this time, and hence, with very low suction on the main nozzle (36), it does not discharge fuel. This high suction beyond the throttle, however, causes the idle system to function, since the primary idle delivery (27) delivers into the high suction zone above the throttle. Fuel from the fuel bowl (15) passes through fuel channel power jet (44) into main nozzle bore (37), where it passes through idle supply opening (41) in main nozzle through idle fuel orifice (42) in idle tube (43) where it is mixed with air allowed to enter idle tube through primary idle air vent (14) and secondary idle air vent (13).

Resultant rich emulsion of fuel and air passes upward into idle emulsion channel (25), where it is finally drawn into throttle barrel through primary idle delivery opening (27), subject to regulation of idle adjusting needle (24), where a small amount of air passing throttle fly mixes with it, forming a mixture for idling. Idle adjusting needle controls quantity of rich emulsion supplied to the throttle barrel, and therefore controls the quality of the idle mixture. Turning needle away from its seat richens idle mixture to engine, and turning needle toward its seat leans idle mixture.

On idle, some air is drawn from throttle barrel above throttle fly through secondary idle delivery opening (29) and blends with idling mixture being delivered to engine, subject to idle adjusting needle. Secondary idle delivery begins to deliver idling mixture to engine as throttle is opened, coming into play progressively and blending with primary idle delivery to prevent mixture from becoming too lean as throttle is opened and before main nozzle (36) starts to feed.

Fuel delivery on idle, and at steady propeller speeds up to approximately 100 rpm, is from the idle system. At approximately 1 080 rpm suction from increasing amount of air passing through primary (34) and secondary venturi (32) causes main nozzle (36) to start delivering, and idle system delivery diminishes due to lowered suction on idle delivery openings as throttle fly is opened for increasing propeller speeds, until at approximately 1 400 rpm idle delivery is practically nil, and most of fuel delivery from that point to highest speed is from main nozzle.

Fuel feed at any full throttle operation is entirely from main nozzle. Idle system and main nozzle are connected by idle supply opening (41). Amount of fuel delivered from either idle system or main nozzle is dependent on whether suction is greater on idle system or main nozzle, suction being governed by throttle valve position and engine load. Main nozzle feeds at any speed if throttle is open sufficiently to place the engine under load which drops the manifold suction. Under conditions of low manifold suction of throttle, main nozzle feeds in preference to idle system because suction is increased on the main nozzle by restriction of venturi.

Main nozzle is supplied with fuel from fuel bowl (15) through metering sleeve (19) and fuel channel (44). Fuel passes upward through nozzle bore where it is mixed with air drawn from nozzle air vent (35) and nozzle bleed holes (40) and discharged from nozzle outlet through nozzle air vent, then sweeps fuel from nozzle well (39) and nozzle bore under very low suction and therefore satisfies any sudden demand for fuel delivery. Nozzle and idle air vent entrance is provided with air vent screen to prevent clogging of vents with bugs and foreign matter.

To provide a leaner mixture for full economy in cruising range, back suction economizer is provided. This has no moving parts, consisting of connecting channels from throttle barrel to sealed fuel bowl. Economizer hole (10) at throttle barrel is located accurately with respect to throttle so that in cruising range this hole is brought into communication with the manifold suction above throttle, which suction is transferred to sealed fuel bowl through economizer channels (9). Suction in economizer channels is modified by atmospheric bowl vent (11), which places on fuel bowl a differential suction between manifold suction and atmosphere. This diminishes fuel flow to nozzle and idle system.

Marvel Schebler's Model MA 3A aircraft carburetor.

Altitude control consists of altitude control lever (5), to which is attached altitude metering valve assembly (16). Altitude metering valve assembly is provided at its lower end with altitude metering valve (17), which rotates in stationary altitude metering sleeve (19). Altitude metering sleeve has slot through which fuel enters. Fuel metering is accomplished by relative positioning of one edge of flattened altitude metering valve and one edge of slot in altitude metering sleeve (19).

When altitude control lever is in position nearest to carburetor flange a full power mixture is provided for takeoff. To make mixture leaner for altitude compensation, altitude control lever is moved away from carburetor flange. With altitude control lever in the leanest position, sufficient compensation for 14,000 ft. is provided.

Altitude adjustment should not be used under 3 000 ft. When adjusting for higher than 3 000 ft. control should be moved in and out slowly with throttle full open until the highest rpm is attained. Carburetor mixture will then be correctly adjusted for all throttle positions and loads at that altitude.

Altitude control should always be in full rich position, which will be in toward instrument panel when coming in for a landing. Thus if full power is required in an emergency near ground, engine will operate satisfactorily and will not overheat because of too lean a mixture.

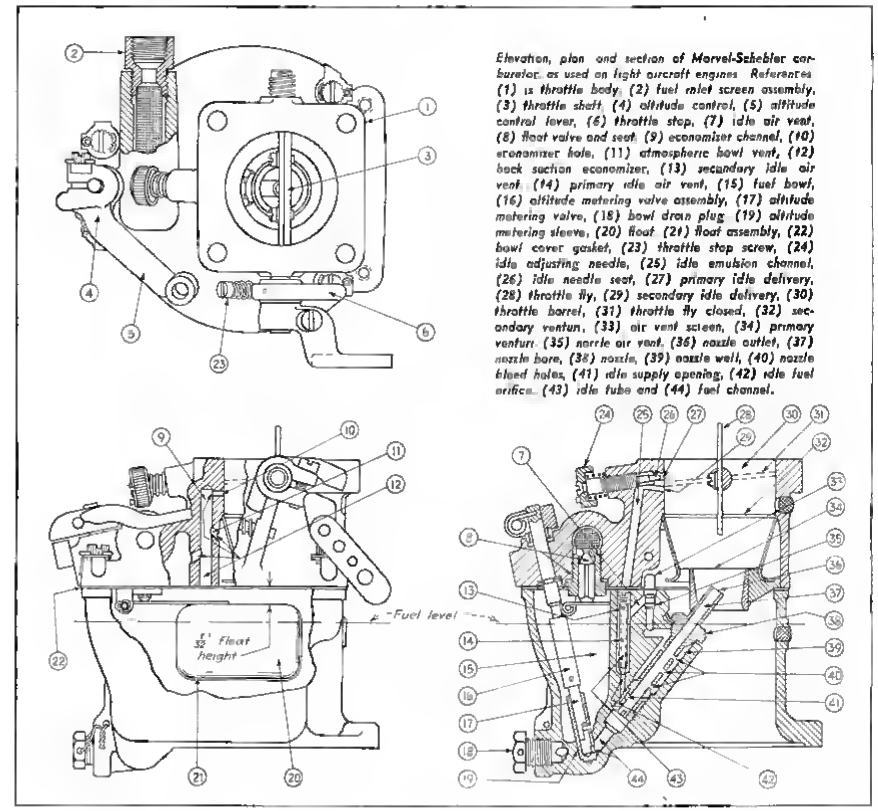
Adjustment of Carburetor

If, after checking all other points on engine, it is found necessary to readjust carburetor, proceed as follows:

With engine thoroughly warmed up, set throttle stop screw (23) so that engine idles at approximately 550 rpm. Turn idle adjusting needle (24) out slowly until engine "rolls" from richness, then turn needle in slowly until engine "lags," or runs irregularly from leanness. This step will give an indication of idle adjustment range and of how engine operates under extreme idle mixtures. From lean setting, turn needle out slowly to richest mixture that will not cause engine to "roll" or run unevenly. This adjustment will, in most cases, give a slower idle speed than a slightly leaner adjustment with the same throttle stop screw setting. However, smoothest idle operation is thus obtained. A change in idle mixture will change idle speed and it may be necessary to readjust with throttle stop screw to desired point. Idle adjusting needle should be from ¾ to 1 turn from its seat to give satisfactory mixture.

Care should be taken not to damage idle needle seat by turning needle too tightly against seat, since damage will make for great difficulty in getting a satisfactory idle adjustment.

Float height, which is set at factory can be checked by removing throttle body and bowl cover and float assembly (21) and turning upside down. Properly set floats (20) should measure 7/32 in. from bowl cover gasket to closest surface of each float. Be sure to check both floats to proper dimensions, making certain that they are parallel to bowl cover gasket.



Elevation, plan and section of Marvel-Schebler carburetor as used on light aircraft engines. References (1) is throttle body, (2) fuel inlet screen assembly, (3) throttle shaft, (4) altitude control, (5) altitude control lever, (6) throttle stop, (7) idle air vent, (8) float valve and seat, (9) economizer channel, (10) economizer hole, (11) atmospheric bowl vent, (12) back suction economizer, (13) secondary idle air vent, (14) primary idle air vent, (15) fuel bowl, (16) altitude metering valve assembly, (17) altitude metering valve, (18) bowl drain plug, (19) altitude metering sleeve, (20) float, (21) float assembly, (22) bowl cover gasket, (23) throttle stop screw, (24) idle adjusting needle, (25) idle emulsion channel, (26) idle needle seat, (27) primary idle delivery, (28) throttle fly, (29) secondary idle delivery, (30) throttle barrel, (31) throttle fly closed, (32) secondary venturi, (33) air vent screen, (34) primary venturi, (35) nozzle air vent, (36) nozzle outlet, (37) nozzle bore, (38) nozzle, (39) nozzle well, (40) nozzle bleed holes, (41) idle supply opening, (42) idle fuel orifice, (43) idle tube and (44) fuel channel.

Starting—Cold Engine

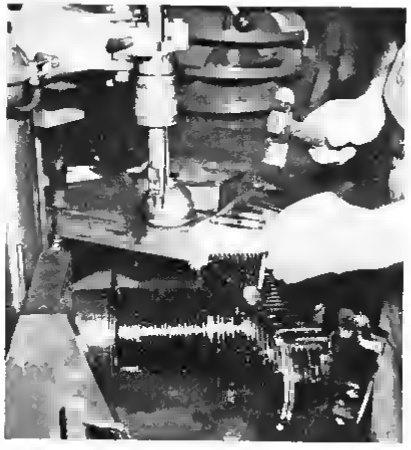
Open and close throttle two or three times depending on air temperature, and set throttle stop approximately 3/32 in. from throttle stop screw. With throttle in this position, turn engine over two or three times before ignition is turned on. This will draw a finely emulsified mixture of air and fuel through manifold into combustion chamber and then if ignition is turned on, engine should start on next turn. And with throttle stop 3/32 in. from throttle stop screw there should be sufficient throttle opening to keep engine running. Carburetor is calibrated to give richest mixture at this opening hence a cold engine will run smoothest with throttle in this position. For this reason engine should be allowed to warm-up for several minutes before opening throttle further.

Starting—Hot Engine

To start a warm or hot engine pull throttle stop against throttle stop screw in idling position. If engine has just been shut off, turn on ignition then engine should start on first turn. But if engine has been shut off for several minutes it may be necessary to turn engine over once or twice before turning on ignition. A warm or hot engine should start and continue to run with throttle in idling position. If it does not do so, ignition should be checked.

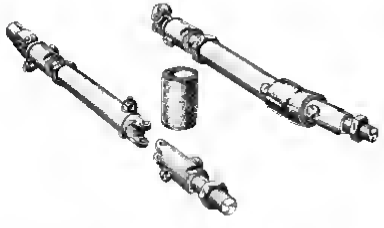
RAF Uses Swinging Motor Crane

• This "all-around" motor-driven crane is used by ground forces of RAF at Gibraltar for engine change and other heavy lifting. Capacity is equal to hoisting heaviest single units used on any aircraft. When crane is locked straight, fore and aft drive to road wheels is connected and crane becomes self-propelling.



Improved Staking Punch

• Lycoming formerly had trouble in the operation of staking keeper pins used on spark plug bushings. When a prick punch was used for the work the metal of the cylinder head was frequently cracked because of slippage. The new tool was made from a steel bar with a ⅜ in. hardened ball inserted in the end. After the ball is inserted the feather edge of the hole is turned over to retain the ball. The opposite end is chamfered and hardened. Tool has reduced scrap loss by 98 percent.

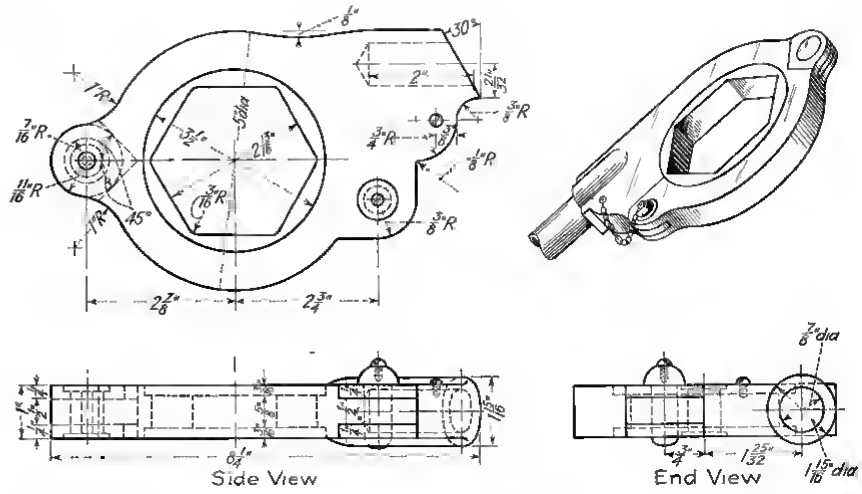


Southwest's Simple Safety Device

• "Three cent life insurance" is protecting planes and pilots at Falcon field, British Training School operated by Southwest Airways at Mesa, Arizona, where safety records for training flights have recently shown even better results than formerly.

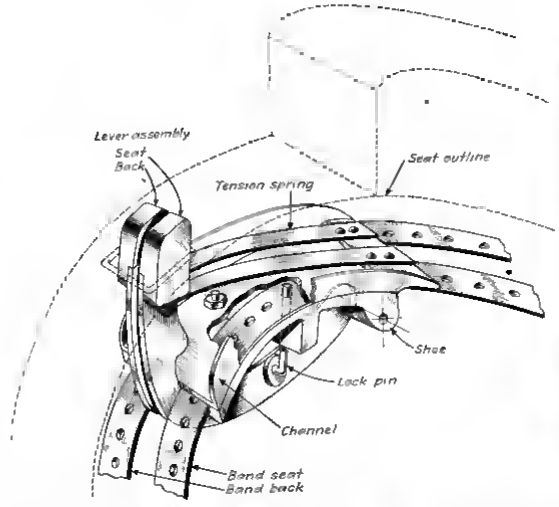
And all because Maintenance Superintendent Joe Wischler was able to attribute a near crash to broken locking pins in the flap universal actuating joint.

Wischler's solution to the problem is a three-cent length of common oil hose, 1½ in. long and with a diameter of ¾ in. This flexible tubing slips over the flap universal actuating joint and seals locking pin segments in place even though they should break. Without the safety sleeve the broken pieces drop out and the assembly falls apart. But with the safety coupling in place operation of the flaps is not impaired even if pins do break.



American Airlines' New Governor Wrench

• By making wrench in hinged halves, AA saves much time in adjusting propeller governors.



United Improves Plane Seats

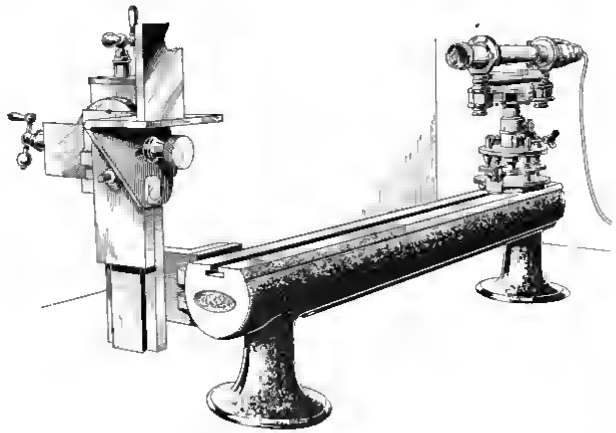
• Herbert A. Lebert, chief production clerk at United Air Lines' Cheyenne maintenance base, displays two airline seat-reclining devices. In his right hand is United's old device, which weighed 2¼ lb. and cost $45. In his left hand is his own device, adopted for use on all United "Mainliners", which weighs mere ¾ lb. and can be built for only $5. Invention, which saves 42 lb. in weight per plane, won Lebert $1,000 award. Sketch details device.

DC-3 Front-Entrance Stand

• A compact front-entrance stand was recently designed for TWA personnel. This stand (sketched here) is very light in weight, is portable, and may be used in conjunction with other equipment while servicing work is accomplished in hangar

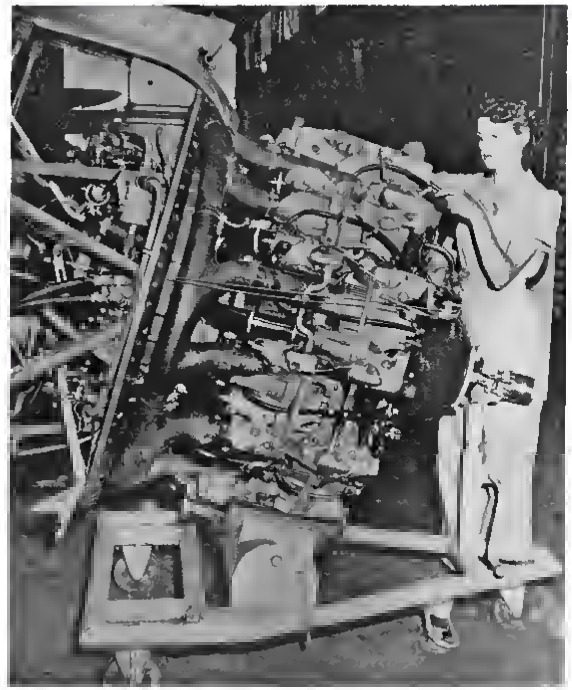
Device for Testing Avigation Octants

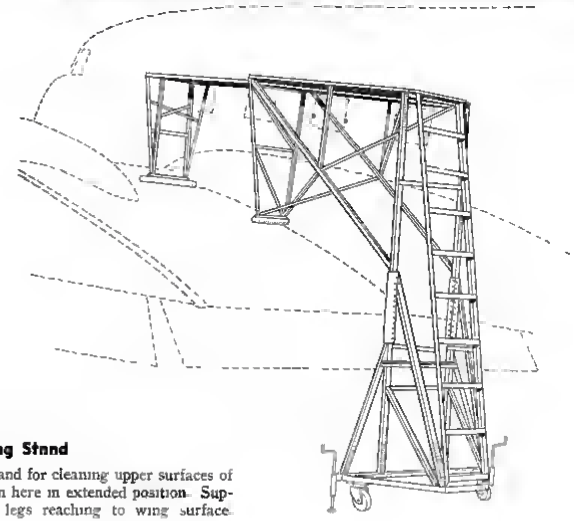
• Pan-American uses a surveyor's transit as an accurate means of checking octants used by avigators on their ocean-going *Clippers*. Octant to be tested is mounted at left on what was slide rest of the precision lathe which has been transformed into test stand.



Engine Cradle

• Pan American developed this stand in order to provide greater accessibility than was the case with the old style angle steel frame. The engine rests on a rocking cradle and the propeller shaft is held by a hand-operated clamp which permits the engine to be tilted. A foot lock prevents the stand from moving when in use.





Fuselage Cleaning Stand

• TWA uses this stand for cleaning upper surfaces of DC-3's. It is shown here in extended position. Support is by padded legs reaching to wing surface.

PARKS STUDENT AIRLINE IS THE REAL THING

Simulating scheduled airline operating practice in all of its phases, students of Parks Air College have readied this Stinson "Reliant" for a trip to a midwest city carrying passengers, mail and cargo.

By GENE KROPF

Airline Operations Instructor, Parks Air College

Parks students make actual flights to middle west cities. Complete airlines operations are carried out—from ticket selling to scheduled flight operations.

The captain and first officer check their maps. Even though trip navigator is responsible for correct flight plotting, flight crew must check his work and be able to make corrections enroute. This double check insures safe and efficient operation.

THIS SPRING the Parks Air College Airline began its tenth year. Operated and managed by the advanced Aviation Operation Engineering School students, PACA is the only non-profit airline in the country.

It came into being to fill a need for students in training—to give them actual airline experience along with their theory. Each year for a period of three months, PACA "employees" set up and run, in regular scheduled service, trips to four cities. Using East St. Louis as a base, flights are made to Chicago, Kansas City, Indianapolis and Memphis. Students majoring in professional flight serve as Captains, and a properly licensed flight instructor acts as Co-pilot. The flights are operated on the same business-like basis as the regular airlines.

During the period of operations, the students are rotated through the various airline positions so they may secure actual experience in each. The length of time spent in any one position is determined by the number of students in the class or, if they intend to specialize, in any one of the various branches of operations or traffic work. Positions from Station Manager right along through the job of Line Mechanic are student responsibilities, and some of the problems presented to the station personnel would tax the ability of the most experienced operators.

The student Captain is required to have some 200 hr. to his credit by the time the airline term rolls around. The instructor pilot who serves as First Officer has thousands of hours in his log book and is well qualified to serve as check pilot.

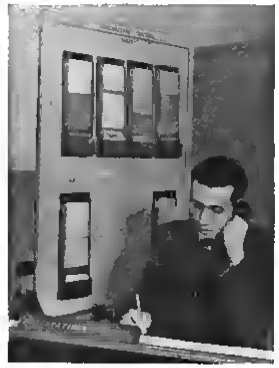
Flight plans that are identical with those used by major lines are prepared by the Captain. Working in close harmony with the flight superintendent and the chief meteorologist, the captain carefully plots his course.

The Stinson "Reliant" used for all flights is equipped with two-way radio facilities, and a constant check is maintained between the aircraft and the ground station at St. Louis. Following his flight plan and using the various aids to navigation provided along the civil airways, the captain keeps his flight on a strict 2-hr. schedule. As the flight progresses, the captain enters a running log of the trip on the reverse side of the flight plan, thus providing a check on his operations. The captain is also responsible for checking the "Trip Forecast." This is a form prepared by the meteorologists who chart all necessary weather information on the route to be flown. At the end of the trip the captain is able to give the meteorologist helpful suggestions concerning this important form.

The flight superintendent is responsible for the dispatch or cancellation of all flights, just as he is with the larger lines. Working with the captain and the meteorologist, his decision as to the status of the flight can be questioned only by the captain. All authorizations for gas loads, cargo loads, and passenger loads above the regular number, must originate with the flight superintendent. Since at least three trips are flown each week, his task is very similar to that of a flight superintendent with a major airline. He is qualified to handle this assignment, however, for he has had nine months of theory in the operation and dispatching of aircraft.

Final weather check before departure is made by captain, flight superintendent, and meteorologists. Late weather is studied, then a final decision is made on day's operation.

Reservation control agent issues and accepts all passenger space for PACA flights. Master charts similar to those employed by airlines are used.



The meteorologist, usually working in a shift with several assistants, is responsible for the drawing of all weather maps used during the operations. He must keep the other departments of the airline advised of the latest changes and work with the flight superintendent when it appears that a trip will cancel or hold. These students have received about nine months of meteorology, including airline forecasting, when they assume this important position.

This is one of the most responsible positions in the operations. Working under the supervision of a competent instructor, these students are encouraged to make their own decisions. Forecasting for the entire PACA system is done from the East St. Louis office, so they actually receive some experience in long-range forecasting.

Handling all of the radio contacts for PACA are the radio operators. These students are the holders of Federal Communication Commission licenses and are fully qualified to operate the type of equipment being used. A national receiver capable of picking up the airliner during its entire flight assures the station of accurate information concerning the flight. It also serves as a check on the radio work

(*Turn to page 257*)

Accepting actual express packages and dummy mail pouches for shipment, these cargo agents prepare necessary forms and collect any charges involved in transaction.

Radio operator is shown sending and receiving reservation messages to secure continuing space for airline passengers. Both radio telephone and code are employed.

FLY-YOURSELF IS BIG BUSINESS

By **HOWARD AILOR**, *Founder Ailor Fly-Ur Self System, Inc., and now President of Aircraft Services Consolidated, Bloomsburg, Pa.*

It will cost more than a quarter and take lots of faith, says the man who operated America's only such service. Here he discusses problems, reveals what capital and equipment will be required.

PREDICTIONS regarding the "rosy" future of aircraft rentals (such as the "Fly-Ur-Self" service operated before the war by the writer) are becoming so numerous as to represent a definite threat to the financial solvency of many who might be sold on the idea.

First, let it be said that reasonable profits can and will be made from such Fly-Ur-Self operations. But on the basis of experience gained through operating the largest such service in America before the war, it must be said— and said plainly —that running such a base is no bed of roses.

An examination of the problems reveals immediately that a fly-yourself base cannot be a shoe-string operation, it can't be set up on two bits and a lot of faith. First, there is the matter of flying equipment. Speaking again from experience, it must be reported a successful operation will require at least ten planes, all fully equipped for night and blind flying, all fully covered by insurance to protect the customer as well as the equipment. Moreover, this minimum of ten planes must embrace different types, including two-, three-, and four-place craft, with four of the latter—and most expensive—probably being needed.

Jolting as the need for the larger and more expensive planes may be from a financial standpoint, this type of equipment must be provided, for the writer's experience showed that about 80 percent of the business was done with craft renting for $15 or more per hour—the Wacos, Stinsons, Fairchild 24's and similar sized planes. It is believed that under present conditions about 60 percent would represent a minimum ratio of such business to be done in the future, for repeat business generates mostly with businessmen to whom time and comfort are essentials.

While complete insurance coverage is essential, it should not prove an insurmountable obstacle. Our prewar business, which served to test a "guinea pig" policy, developed premium rates which were actually lower than current War Training Service rates. It is felt safe to assume that a growing volume of well-run and consequently safe, self-flying business would bring about further premium reductions.

Assuming, however, that adequate finances are available to purchase and insure the required number of planes, there is another important financial matter to cover.

This involves establishing credit ratings, upon which courtesy cards can be issued to customers and prospects. It takes a lot of prospects to make a Fly-Ur-Self service, and it takes a lot of money to evaluate those prospects. In our prewar operations, for example, it cost $3.75 to get each courtesy card into the hands of the customer or prospect. This figure included investigations, which were made by two leading credit organizations; printing of questionnaires and identification cards, mailing and other direct charges. We found no way to short-cut this operation, the writer sees no way to operate in the future without similar investigations to establish a clientele with sound credit ratings.

In this connection, it should be pointed

(*Turn to page 297*)

Postwar self flying services will have to be sold just as they were before the war—and that means plenty of advertising aimed at a specific audience, as the author points out so clearly in this article. Here are samples of ads that worked successfully before the war.

Are Airline Stock Values Real?

By **RAYMOND L. HOADLEY**
Financial Editor, "Aviation"

Air transport revenues fluctuate with passenger load factors, and investors should be aware of the nature of present business and be prepared for a marked curtailment in the early postwar period. While remaining a first class investment, appreciable returns on airline stocks may be realized only in the long future.

QUESTION: Are investors in the airlines prepared for the postwar adjustments facing this industry? If not, the airline stocks are likely to sell much lower than they do today.

Large numbers of investors have bought airline stocks in the last two years in anticipation of the coming golden age of air transportation. But many of them do not realize (1) that this golden age may be nearly a decade away as far as big earnings and dividends are concerned, and (2) that the industry's problems of the next few years may have considerable influence on stock market prices.

Reams have been written about the adjustments facing the aircraft makers while the romance of future expansion has had all the priorities when it comes to the airlines. True, the airlines' postwar problem is not one of survival because, unlike the aircraft manufacturers, these transport organizations generally are in satisfactory shape. The trouble is that the market probably has discounted perhaps excessively, the problems of the aircraft group while failing to realize that the airlines, too, have adjustments to make that may have repercussions marketwise.

Public psychology in and out of Wall Street, has always favored the airlines. Their steady growth, first in traffic volume and then in earning power, has made a favorable and lasting impression. But if a sudden and unexpected drop in earning power occurs after the war, as it probably will, the public may well sour on these stocks at present price levels.

Already American Airlines and Eastern Air Lines have reached the peak of their wartime earnings due to the excess profits tax. United Air Lines and several others are rapidly approaching the point where the excess profits levy will step in to put a ceiling on profits. Carry-over provisions in the tax laws no longer will keep them out of the excess profits tax brackets.

And in the case of the smaller lines several already have shown a surprising drop in profits, even in wartime. Chicago & Southern, which Wall Street expected to earn around $350,000 in 1943, actually reported $128,000 against $277,000 in 1942. At the same time Western Air Line's net profit dropped from $693,700 in 1942 to $90,000 last year.

Fact is that while the airline industry has made amazing strides in gaining its maturity, it has not yet reached full-bloom stability. Stockholders should not expect any miracles in these first postwar years. An expanding gross business will not necessarily mean expanding profits.

Present earnings are highly abnormal in relation to gross business. Current load factors of better than 90 percent can hardly be maintained under competitive peacetime conditions. Trade estimates place the postwar payload back around 60 to 70 percent. One accompanying table of statistics on payloads and earnings for the domestic airlines in the last six years shows the close relationship that always exists here. Some of the industry's most competent observers feel that the 1942-44 period will be looked back upon years hence as the most favorable operating period ever experienced.

Reductions in passenger fare and express rates last year, as well as cuts in airmail pay, may well prove to have been premature. It should be noted that many of the lines still are dependent upon airmail for a large part of their income. This is true even though for the industry as a whole airmail accounts for only 20 percent of revenues received while passenger fares provide about 70 percent. In 1931 mail provided 82 percent and passenger fares only 17 percent.

Not long ago the Civil Aeronautics Board retroactively adjusted the airmail rate of Braniff Airways. This decision cost shareholders about 35c a share on 1943 earnings by reducing them to 61c a share on the 1,000,000 shares outstanding. The sharp drop mentioned above in Western Air's 1943 earnings is attributable to a $500,000 decline in mail revenue, along with the 10 percent decrease in passenger rates and 12½ percent in express rates. Yet WAL passenger revenue was up 38 percent. Chicago & Southern in turn received a mail pay

(*Turn to page 251*)

How Earnings Follow the Payload

	Operating Profit	Rev. Pass. Load Factor
1938	*$1,016,508	39.43%
1939	4,556,285	56.20
1940	5,967,028	57.90
1941	7,302,000	59.13
1942	26,544,164	72.21
1943	31,753,000	88.01

* Deficit

New Budd Steel Cargo Plane Has Many Unusual Features

Developed for Navy as cargo or troop carrier, "Conestoga" has exceptionally large freight compartment; two side doors would halve unloading time when used on paratroop missions.

CONSIDERABLE INTEREST attended the official unveiling of the E G Budd Mfg. Co. stainless steel cargo plane, the *Conestoga*, last month.

Marking a considerable departure from conventional design, the *Conestoga* presents a strange appearance to those accustomed to sleekness and straight lines. Characterized in aspect by a marked cockpit "hump", a tremendous afterbody upsweep and a liberal dihedral in the horizontal stabilizer, the ship has all the appearance of a flying boat on wheels.

However, the plane was conceived as a pure cargo type and all of its unusual features are fully functional. Principal objectives were to achieve an efficient flyable box-car, with dimensions of 8 by 8 by 25 ft, wholly unobstructed by structural members and capable of rapid loading and unloading.

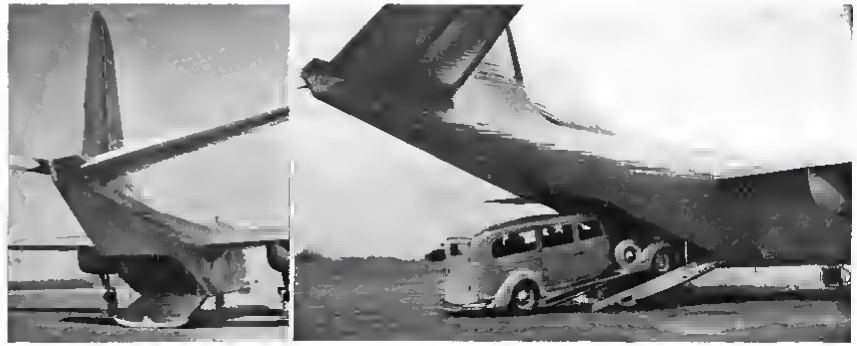
The designers settled on rear loading and a large hinged door was provided which lowers to the ground forming a ramp for easy loading as well as an uncommonly large door area. In addition sizeable doors are provided at each side of the fuselage. Tricycle landing gear maintains the compartment level on the ground, facilitating stowage. These features in combination with the large afterbody upsweep make it possible to load cargo of considerable dimensions. Provision is made for handling cargo with the aid of a hoist located at a roof truss just over the ramp, and a winch is located at the forward bulkhead so that heavy equipment may be hauled into the compartment.

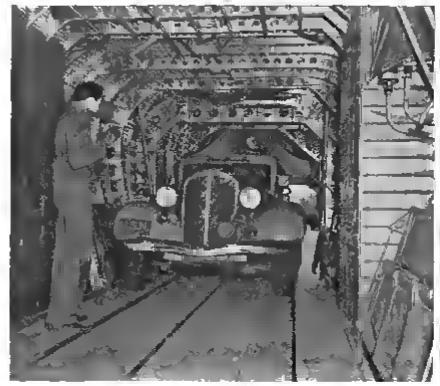
The cockpit "hump" is occasioned by provision of a flight deck of generous proportions. The deck is above the cargo level and is reached by a stairway adjacent to an entrance door on the left side of the fuselage, just forward of the cargo compartment.

The *Conestoga* is fabricated of welded stainless steel virtually throughout. Its gross weight is 33,800 lb of which 10,400 lb is payload. It has a wing span of an even 100 ft, and is 68 ft. long. Equipped with two 1,200 hp engines, it cruises at 165 mph. and has a normal range of over 600 mi. and maximum range of 1,700 mi. It is capable of takeoff with full load in 920 ft.

Although primarily a cargo carrier, the airplane can be converted to troop transport or aerial ambulance use. Provision is made for 24 seats and 24 stretchers. The two side fuselage doors would permit unusually rapid egress of paratroopers.

The *Conestoga* was developed under the sponsorship of the Navy Department Bureau of Aeronautics, and is being built under a Navy contract.





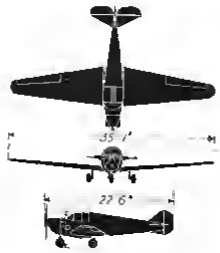
Accompanying photos reveal radical departures from conventional design and show graphically large amount of space available in rear-loading cargo compartment

DESIGN FOR TOMORROW

"Rocket" A-75, designed by William T. Gregg, president of Gregg Aircraft Mfg. Co., in flight. Plane is of aluminum alloy construction, with semi-monocoque fuselage from firewall to aft of cabin, full monocoque from there to tail post. Wings are full cantilever, stressed skin design, with two full length shear beams and detachable wingtip. With Continental A-75 engine 'Rocket' cruises at 110 mph.

Two-place side by-side Gregg 'Rocket' is equipped with steerable tricycle landing gear, all struts having 6 in. stroke hydraulic-spring shock units. Nose wheel is controlled by positive push-pull tubes; rear wheels have hydraulic brakes controlled by single pedal. Cabin entrance is through fore and aft sliding panel of dural frame and Pyralin.

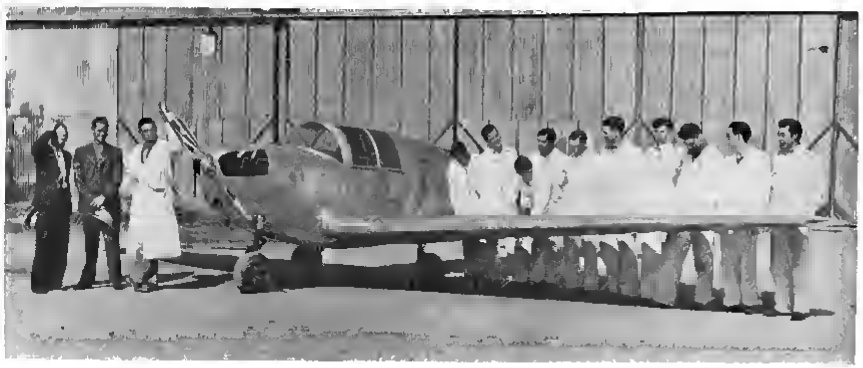
The Rocket A-75



Three-view silhouette of "Rocket" A-75.

Rocket A-75
Specifications and Performance Data

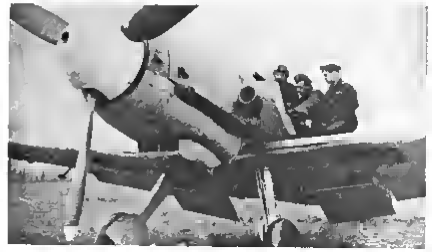
Span	35 ft. 11 in.
Length	22 ft. 6 in.
Height at cabin	6 ft.
Gross wt.	1,275 lb.
Wt. empty	734 lb.
Wing section	NACA 23012 Tapered
Wing loading	6.03 lb./sq. ft.
Landing gear	steerable tricycle (single strut, 6-in. oil-spring stroke)
Fuel capacity	16 gal.
Oil capacity	1 gal.
Range	440 mi.
Cruising speed	110 mph.
Climb	850 ft. per min.
Power plant	one Continental A-75



Captured Nazi Planes Yield Secrets

The "inside story" of enemy's newest aircraft types is uncovered as RAF puts captured craft in condition for thorough flight testing. Here left to right, are shown Junkers Ju-88, Messerschmitt Me-110, Messerschmitt Me-109G, Focke-Wulf Fw 190A3, and Henschel He-129, latter still undergoing repairs and retaining German markings. (British Combine photo.)

RAF mechanics give "once-over" to 1,200-hp Junkers "Jumo" engine of captured Ju-88, one of Luftwaffe's workhorse planes. Originally designed as a medium bomber, the type has been pressed into service as dive bomber, night fighter, and even as day fighter in desperate though futile attempt to stop AAF's 8th Air Force day fight attacks on Germany. Photo clearly shows 'bathtub' arrangement, on lower right side of fuselage, used to house battery of machine guns and cannon. (British Combine photo.)



Close-up shows details of Messerschmitt Me-109G, latest in long line of type first combat-flown back in Spanish Civil War. Craft still retains comparatively narrow landing gear typical of this type, but spinner size has been greatly increased. Rounded air scoop set in side of cowling just above exhaust stacks was originally installed for desert operations of African campaign, but apparently it is now standard for all theaters. Power has been boosted from 650 in prototype to 1,600 in model shown above. (British Combine photo.)

Stripped Henschel Hs-129 reveals construction details of this ground-attack craft. Note Junkers-type 'floating' ailerons similar to those used on Ju-52 transports, also fact that outer wing panel has but three ribs between tip and center section attaching point. Craft is powered by two 650 hp Gnome-Rhone radials. Armament includes two 20-mm. cannon in nose and one 30 mm. cannon in belly. (British Combine photo.) Photo above shows how craft appears 'unstripped' and in flight.

Engine Plant Grows Almost Over Night

Two-thousand horsepower engines are now coming, in Victory flow, from lines on ground which "hardly yesterday" was just peaceful Missouri Valley countryside.

ABOUT TWO YEARS AGO a small group of men stood in a field near Kansas City. Around them were farms and wire fences and white houses surrounded by trees. The only signs of life were the usual activities of rural Kansas.

Now, the same place is occupied by one of the largest engine plants in the world, already producing a large proportion of the highest powered aircraft engines made in this country.

If this achievement had merely been a matter of running up a huge group of buildings in record time, it would be worth recording. If the transformation of cornfields into a factory had been the only problem, its successful solution in less than two years would still be noteworthy. But though these two factors loomed largely in the task which lay ahead of the Navy and Army and Pratt & Whitney Aircraft, there were far greater obstacles to be overcome before the R-2800-C engines could flow off the assembly lines in that steady, never ending stream which is an accepted fact in American industry but is seldom or never seen elsewhere.

The buildings could be erected, there were sufficient engineers, designs had already been completed, but—who would build the engines? Where, in a prepondederantly farming community, could nearly 30,000 mechanics be found? Let us quote Rear-Admiral Ramsey, Chief of Navy's Bureau of Aeronautics. . . . we knew however that we had in America four priceless resources . . . ingenuity, raw material, productive capacity and Americans who are independent, intelligent, resourceful and aggressive . . . capable of undertaking any task, no matter how alien to the work they had done in times of peace."

"Pratt & Whitney and the Bureau of Aeronautics knew how many engines we would want and how many thousands of former farmers, packing house workers, salesmen, housewives and others unfamiliar with precision tool work would be required, who must be trained to man such a plant and meet production schedules. . . . We needed light and power and heat and transportation for the workers —in a region largely agricultural we had to find trained mechanics to set up a training school to transform these sturdy Missouri Valley men and women into accomplished machine tool operators. Finally, we needed those intangibles that are a vital part of this country's greatness— know how' and teamwork. We got them all. You see, we got those last two first—"know how" and teamwork—and, somehow or other, with those, the other problems resolved themselves one after the other."

So the plant was built in a lovely valley about eleven miles from the city. While the buildings were being erected from non strategic materials, H. Mansfield Horner, president of the company had formed schools which taught those who were to become the mechanics in the huge workshops and the inspectors on whom the responsibility would rest of checking the output of one of the largest aircraft engine plants in the world. The results of this planning are best shown by what others say about them.

Speaking recently at Kansas City, Brigadier-General Perrin, AAF, said, "Every month Pratt & Whitney powered planes are flying millions of miles—across oceans and continents, over the Himalayas, in the cold of Russia and over the steamy jungles of the South Pacific . . . and having met this good old name of Pratt & Whitney all over the world, it seems natural to find it tucked away in the Missouri Valley, if you can really tuck away a plant covering three million square feet of floor space. Some day, and it can't come any too soon, we will start installing those new R-2800-C engines, made here in Kansas City, in the *Thunderbolts* and when that day comes the *Thunderbolt*, good as it is, will become a new airplane."

The work has not been easy. Tremendous problems were encountered and solved. But today, finished engines, in undisclosed numbers, are rolling off the assembly lines and taking their places as vital elements of the nation's first line of defense. Everyone concerned has a right to a deep feeling of satisfaction that so much has been accomplished so well.

Three million square feet of menace to the Axis. P. & W. Kansas City plant where corn grew 20 months before.

Where this propellar shaft carrying belt now carries results of the work of hundreds of men, there was a field less than two years ago.

The Thunderbolt Strikes!

With its eight 50-calibre machine guns blazing, the Republic Thunderbolt deals out destruction . . . establishing its claim to the title of a World's Heavyweight Champion among fighting planes. Developed in close teamwork with the AAF, the Thunderbolt is a high-flying fighter built to fly and fight in the stratosphere above 37,000 feet. Heavy armor protection, a mighty Pratt and Whitney engine with turbo supercharger and auxiliary fuel tanks for long-range bomber escort duty make the Thunderbolt the heaviest fighter that flies!

THE SCORE

At the main gates of the Republic Aviation Corporation plant at Farmingdale, Long Island, this scoreboard shows the deadly fighting power of the Thunderbolt—993 enemy planes knocked out to 218 Thunderbolts lost. A ratio of better than 4½ to 1!

1230 SIXTH AVENUE **UNITED STATES RUBBER COMPANY** ROCKEFELLER CENTER · NEW YORK 20, N. Y.

NOW THOUSANDS OF POUNDS HEAVIER... AND LIGHTER, STRONGER TIRES DO THE JOB!

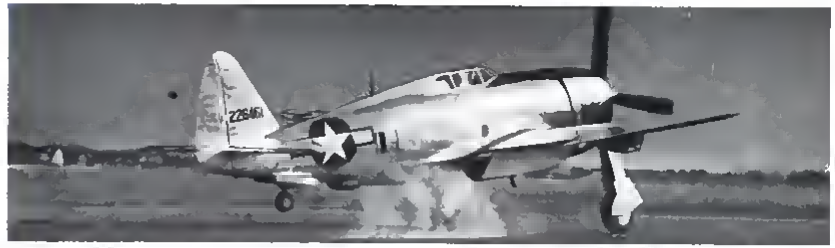
In 1941 the Thunderbolt weighed 12,500 pounds . . . and it was a fighter then that earned the respect of any enemy craft. Today, with added armor and with auxiliary wing tanks and belly tank, the P-47 weighs in, fully loaded, at several thousand pounds heavier. To carry this great extra load at Thunderbolt speed on the same size tire, "U. S." tire engineers developed lighter, stronger U. S. Royal Airplane tires. With the constant cooperation of the AAF, tires were built with bodies of rayon and with treads of natural and synthetic rubber. Test after test in the laboratories and in combat have proved that these new, lighter, stronger U. S. Royal Airplane tires for landing wheels and tail wheels can do that job!

when the Thunderbolt takes off...

AIR-BORNE! With its full load of gas, the P-47 takes off. Under top load, the Thunderbolt's tires have done their first important job—to get this World's Heavyweight Champion Fighter away.

AWAY! The Thunderbolt is on its way to pile up another knockout score. Landing gear folding into place, the 2,000 horsepower supercharged engine takes over the job of climbing to fighting altitude.

and when it lands—



IMPACT! With a sock that sends out blue puffs of smoke, the lighter, stronger tires hit the ground—but with a trail of rubber scuffed off the tread from the sandpaper action of the runway. In this cruelest tire test of all, U.S. Royals are proving their ability to take it on Thunderbolts around the world.

Review of Patents

By A. HARRY CROWELL, *Registered Patent Lawyer*

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York City (18). Printed copies of any of patents listed are obtainable at a cost of 10c. each, directly from U. S. Patent Office, Washington.

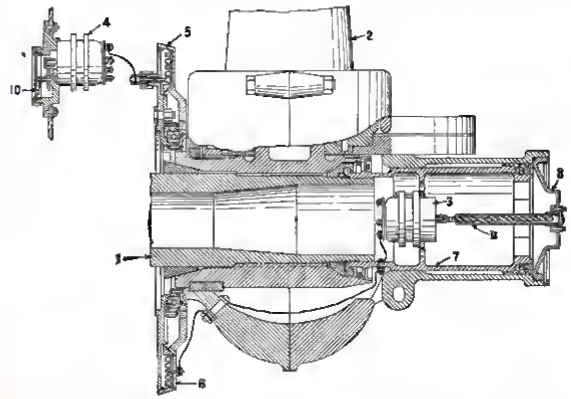
Aircraft Stall Indicating Apparatus also intended, in combination devices, to warn of excessive speed which might cause structual failure through fluttering or other causes is mechanism with appropriately counterbalanced air vanes disposed in airstream. Stall vane is asymmetrically pivoted about a generally horizontal axis so as to move up and down in response to changes in direction of airstream, while high-speed vane is responsive to velocity of airstream. Included is special arrangement of electrical contacts to transmit warnings to pilot.—2,337,723, filed Feb. 24, 1942, patented Dec. 28, 1943. R. D. Lacoe.

Signal Lamp, particularly for use on aircraft is intended to improve safety of night flying at high speed. Device is described as having large luminous area, long range of visibility, and a wide spread to present signal light most effectively to sides, above and below. To attain this result, reflector and cover glass are specially designed, and their arrangement in unit with respect to light source has been gaged for particular signalling efficiency.—2,338,343, filed Nov. 9, 1943, patented Jan. 18, 1944, C. Adler, Jr.

New Aircraft Wing employing two longitudinal spars, has three extensible portions rigidly interconnected between wing tip cap. These extensions can be moved outwardly to increase wing area (lift) during landings and take-offs and each extension is designed to resist bending and twisting forces. First extension is positioned between front spar, second between two spars and third to rear of back spar.—2,344,044, filed Mar. 15, 1941, patented Mar. 14, 1944, R. Koch, vested in Alien Property Custodian.

Portable Airfield of readily transported temporary type employs strips of metal woven together in a sort of basket weave and held to ground around outside borders by attachment thereto. Stresses applied to field are resisted by strips in tension rather than in bending. Strip units of uniform size are interlocked end-to-end to provide a long composite strip for weaving operation.—2,344,131, filed Feb. 18, 1942, patented Mar. 14, 1944, W. C. Coryell.

Bomb Releasing Rack. This rack operable electrically or manually, is composed of an arrangement of parts to achieve operation with minimum energy in releasing substantially heavy bombs. Of light weight materials, operating parts are automatically set when a new bomb is positioned in rack.—2,344,211, filed May 21, 1942, patented Mar. 14, 1944, R. L. Markey, assignor to Pollak Mfg. Co.



Developed for use with controllable-pitch propellers, special position indicator mechanism, sketched here in layout form, is designed to show pilot pitch angle of his rotating propeller blades. Operation is via means for transferring pitch change movements from airscrew blade to indicator. Drawing details cross section of controllable-pitch propeller hub. (1) hetor propeller drive shaft projecting from engine (not illustrated) and carrying propeller (2). Within pitch-changing mechanism is affixed unit (3) comprising relatively fixed stator and wound rotor within stator, and a similar unit (4) is secured to plane's instrument panel. When rotors and stators of these two autosyn-type units are electrically connected and two units are placed in circuit with source of electromotive force. Then if there is rotation of rotor of one unit the rotor of alternative unit rotates same amount. At (5) and (6) are ring-and-brush mechanisms to which, as indicated, there is connective wiring respectively from autosyn units (3) and (4) thus uniting them. In controllable-pitch action, member of mechanism (7) moves relative to member (8) which is interconnected through screw shaft (9) to rotor of autosyn unit (3). Pitch movement registering in unit (3) is identically registered in unit (4) and through gears pointer (10) indicates pitch on suitably calibrated dial in cockpit.—2,337,013, filed June 7, 1940, patented Dec. 14, 1943, E. Martin, assignor to United Aircraft Corp., East Hartford, Conn.

Propeller Construction Patent calls for twin-blade airscrew fashioned from a single blank of double length with the two integral blades having their connecting portion at propeller hub. Blades may have either no stagger at all or a very small stagger. A small stagger is stated to give a useful small overbalance which can overcome average aerodynamic moment. Two blades are connected by light weight stiffener members shaped to entail least possible air resistance.—2,344,905, filed June 27, 1941, patented Mar. 14, 1944, H. Reissner.

Chute-Delivery Container is for transport of more or less fragile articles, such as rifles, machine guns, etc., by dropping them by parachute. Container is light in weight but rigid and strong when packed ready for dropping. After landing release of a single quick-opening fastener will open entire container wide so that articles may be removed in a minimum of time.—2,345,009, filed Apr. 8, 1942, patented Apr. 4, 1944, W. L. Lindsey and H. Wilson for free use by government.

(*Turn to page 273*)

Book Reviews

EMPIRE OF THE AIR, by Matthew Josephson. Harcourt, Brace & Co. 227 pages, illustrations, index. $2.

Mr. Josephson's first chapter starts bravely "On the Power Politics of the Air Age," posing the problems the world will face after the war. Best way to approach these problems, he says, "is to study the early history of Pan American Airways." Chapters II through XII do just that, offering a combination history of the line and biography of its president, Juan T. Trippe. Some of the material was previously published in a magazine serial. Chapter XIII on "The Postwar Air" is a plea for reciprocity and cooperation which must eventually be made worldwide to establish global air lines and maintain the bases from which these airlines will have to operate.

THE LUFTWAFFE by C. G. Grey. Faber & Faber, Ltd., London. 251 pages, photos, index. 8s. 6d. ($1.75)

Appraisal of the German air forces from a British point of view. Traces the history of the Luftwaffe from its earliest beginnings as an outgrowth of the old Imperial air arm, with detailed attention given to the status of German aviation before 1914 and during the course of the first World War.

The latter half of the book treats of the Luftwaffe in its present stage of development. Grey greatly minimizes popular impressions of its size, power and flexibility, going on to express his strong belief accordingly that England never had much to fear from a German invasion. The reader may judge for himself whether the facts have borne out the author's analysis.

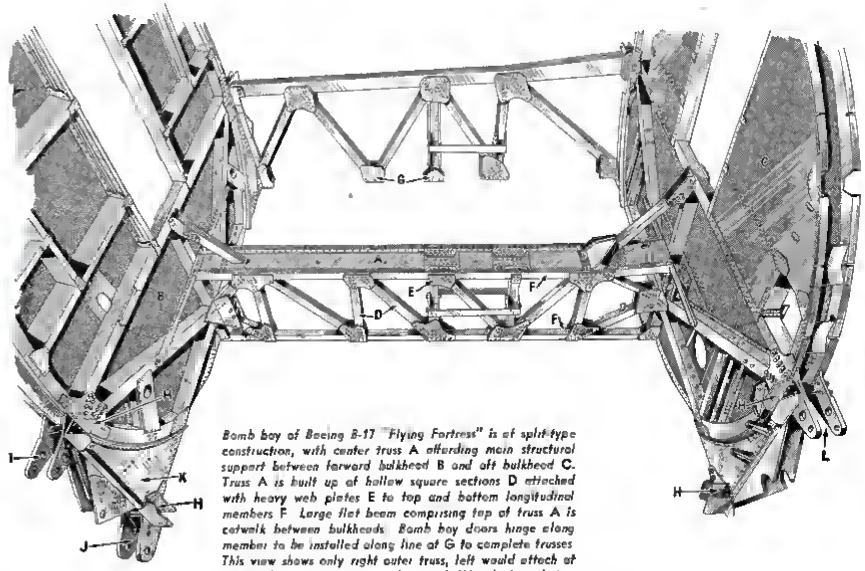
WORK METHODS MANUAL, by Ralph M. Barnes. John Wiley & Sons, Inc., N. Y. 126 pages, illustrations, charts, index. $1.75

The author, a professor of industrial engineering, here undertakes a guide for foremen, supervisors, and plant workers on the principles of work organization and motion economy, pointing up methods of doing mechanical jobs with greater economy and efficiency, with less effort. Pertinent chapters are: Job Breakdown; Process Charts and Flow Diagrams; Mechanized Process Analysis for Mechanized Production Lines; Men and Machine Charts; Motion Analysis; Tools. This is a detailed work for all machine-shop personnel.

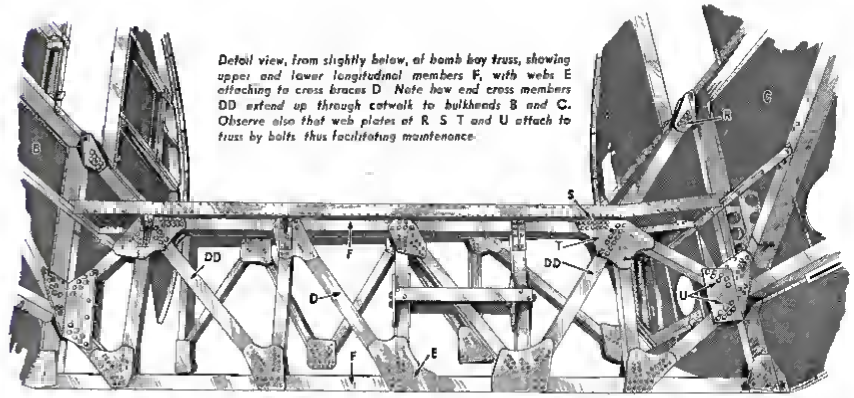
A.S.T.M. STANDARDS ON RUBBER PRODUCTS. American Society for Testing Materials, Philadelphia. 424 pages, illustrations. $2.00.

Enlarged new edition. About 140 pages are devoted to the general methods of evaluating rubber, covering chemical analysis, sample preparation, accelerated aging, adhesion, cure, abrasion and tear resistance, hardness, compression set, changes in liquids. Latest specifications are given for aeronautical and automotive applications of rubber. Also included are War Emergency Provisions and Specifications.

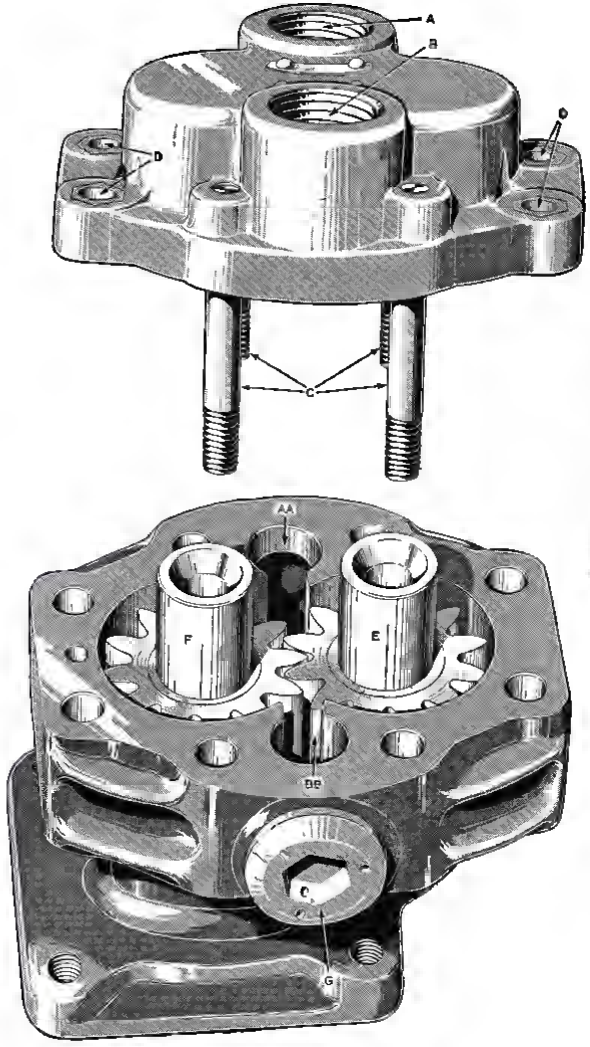
(*Turn to page 275*)



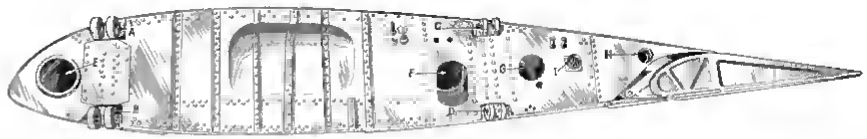
Bomb bay of Boeing B-17 "Flying Fortress" is of split-type construction, with center truss A affording main structural support between forward bulkhead B and aft bulkhead C. Truss A is built up of hollow square sections D attached with heavy web plates E to top and bottom longitudinal members F. Large flat beam comprising top of truss A is catwalk between bulkheads. Bomb bay doors hinge along member to be installed along line at G to complete trusses. This view shows only right outer truss, left would attach at fittings H. Front spar attaches to bulkhead through top fitting I and bottom fitting J, with load carried through to bulkhead by built-up section K. Top fitting for rear spar attachment is seen at L.



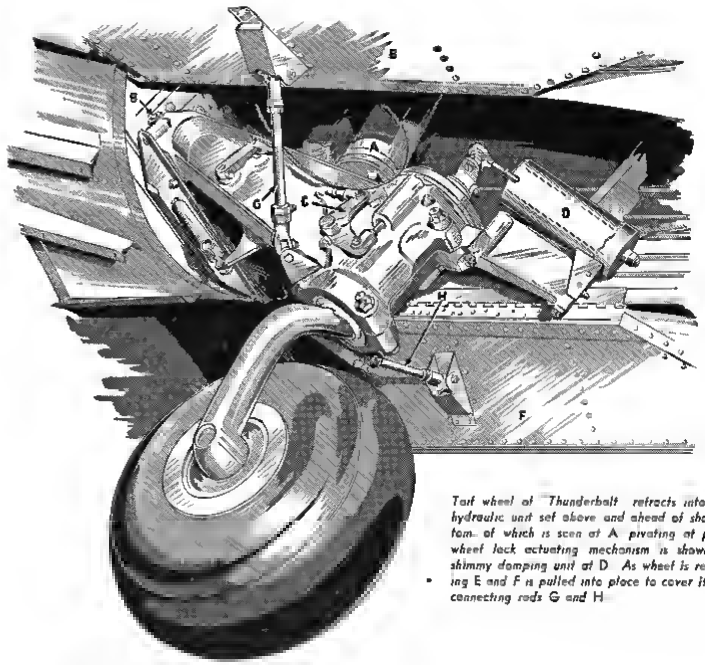
Detail view, from slightly below, of bomb bay truss, showing upper and lower longitudinal members F, with webs E attaching to cross braces D. Note how end cross members DD extend up through catwalk to bulkheads B and C. Observe also that web plates at R S T and U attach to truss by bolts, thus facilitating maintenance.



Exploded view of oil pump from Japanese Mitsubishi 00 "Zeke" fighter. Cap, shown at top with intake A and outlet B, is of aluminum alloy and attaches to pump section by eight bolts—four, at C, screwed into cap itself, and four through holes, D. Pump section is bronze sand casting with gears E and F of high-quality well-machined steel. Flow of oil is from inlet AA around outside of gears to outlet BB. Drive is through gear F from coupling at lower end of gear bearing. Plug G, matched by counterpart on opposite side of pump provides alternate intake and outlet. Whole unit weighs 3 lb. 11 oz., some three times as much as American-built pumps, and construction suggests it was adopted practically on "as was" basis from marine pump design.



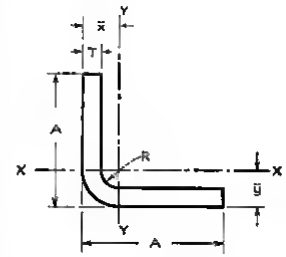
Inboard wing rib of Republic P-47 "Thunderbolt", showing fuselage attachment fittings at A, B, C, and D. Openings E, F, G, and H are for controls, with electric connecting plug set at I. Bulge in rib seen between attachment fittings forms inboard end of landing gear wheel well.



Tail wheel of "Thunderbolt" retracts into fuselage by hydraulic unit set above and ahead of shock unit, bottom of which is seen at A, pivoting at point B. Tail wheel lock actuating mechanism is shown at C and shimmy damping unit at D. As wheel is retracted, fairing E and F is pulled into place to cover it by universal connecting rods G and H.

SHEET NUMBER DB-21
CLASSIFICATION . . . . . AIRCRAFT STANDARDS
SUB-CLASSIFICATION . . . . . ALLOY ANGLES

Below are listed latest N.A.S.C. standards for equal leg, aluminum alloy, rolled form angles



x & y — Locate center of gravity
I — Moment of inertia (inches⁴)
ρ — Radius of gyration (inches)

Material and length to be specified when ordering

Weights shown are for 24S alloy.

Dash Numbers	Dimensions A ± .020	T	R ± .010	Area Sq In.	Weight Per Ft	Dev. Width	Section Elements M	I	ρ
1		.020	.020	.0193	.0235	.969	.134	.00034	.1334
2	.500	.025	.025	.0240	.0293	.963	.136	.00042	.1330
3		.032	.032	.0303	.0372	.947	.140	.00053	.1325
4		.025	.025	.0271	.0329	1.087	.152	.00061	.1497
5	.562	.032	.032	.0343	.042	1.071	.155	.00076	.1492
6		.040	.040	.0423	.0515	1.059	.159	.00093	.1485
7		.032	.032	.0383	.0468	1.197	.171	.00106	.1662
8	.625	.040	.040	.0474	.0580	1.185	.175	.00130	.1656
9		.051	.051	.0595	.0734	1.166	.180	.00161	.1647
10		.032	.032	.0423	.0514	1.323	.187	.00142	.1832
11	.688	.040	.040	.0524	.0640	1.311	.190	.00175	.1826
12		.051	.051	.0659	.0800	1.292	.196	.00218	.1817
13		.032	.032	.0463	.0563	1.447	.202	.00183	.1988
14		.040	.040	.0574	.0702	1.435	.206	.00228	.1994
15	.750	.051	.051	.0722	.0885	1.416	.211	.00285	.1985
16		.064	.064	.0893	.1103	1.395	.217	.00348	.1974
17		.072	.090	.0989	.123	1.375	.222	.00385	.1973
18		.040	.040	.0624	.0760	1.561	.2217	.00292	.2163
19		.051	.051	.0787	.0965	1.542	.2268	.00365	.2155
20	.813	.064	.064	.0973	.1200	1.521	.2330	.00448	.2144
21		.072	.090	.1080	.1342	1.501	.2380	.00496	.2144
22		.081	.101	.1202	.1501	1.484	.2425	.00549	.2137
23		.040	.040	.0674	.079	1.685	.2372	.00366	.2331
24		.051	.051	.0850	.100	1.666	.2423	.00458	.2322
25	.875	.064	.064	.1053	.122	1.645	.2484	.00563	.2312
26		.072	.090	.1169	.153	1.625	.2534	.00624	.2311
27		.081	.101	.1303	.162	1.608	.2579	.00692	.2304
28		.040	.040	.0774	.091	1.935	.2684	.00551	.2669
29		.051	.051	.0977	.115	1.916	.2735	.00691	.2660
30	1.000	.064	.064	.1213	.142	1.895	.2796	.00851	.2650
31		.072	.090	.1349	.157	1.875	.2845	.00937	.2649
32		.081	.101	.1505	.186	1.858	.2890	.01051	.2642
33		.091	.116	.1674	.209	1.842	.2940	.01163	.2635

(Continued on page 251)

SHEET NUMBER . . . . . DB-21, cont'd.
CLASSIFICATION . . . . . AIRCRAFT STANDARD
SUB-CLASSIFICATION . . . . . ALLOY ANGLES

Below are listed latest N.A.S.C. standards for equal leg, aluminum alloy, rolled form angles

Dash Numbers	Dimensions A ± .020	T	R ± .010	Area Sq. In.	Weight Per Ft	Dev. Width	Section Elements M	I	ρ
34		.040	.040	.0874	.105	2.185	.2996	.00790	.3006
35		.051	.051	.1105	.130	2.166	.3047	.00993	.2997
36		.064	.064	.1373	.162	2.145	.3108	.01225	.2987
37	1.125	.072	.090	.1529	.179	2.125	.3157	.01364	.2986
38		.081	.101	.1708	.210	2.108	.3201	.01516	.2980
39		.091	.116	.1902	.235	2.092	.3252	.01681	.2973
40		.102	.153	.2102	.261	2.074	.3323	.01856	.2972
41		.125	.187	.2522	.319	2.019	.3444	.02203	.2955
42		.040	.040	.0974	.118	2.435	.3309	.01089	.3344
43		.051	.051	.1232	.146	2.416	.3360	.01371	.3335
44		.064	.064	.1533	.181	2.395	.3420	.01694	.3325
45	1.250	.072	.090	.1709	.200	2.375	.3469	.01889	.3324
46		.081	.101	.1910	.235	2.358	.3513	.02102	.3318
47		.091	.116	.2129	.261	2.342	.3563	.02334	.3311
48		.102	.153	.2357	.294	2.324	.3634	.02581	.3310
49		.125	.187	.2835	.356	2.269	.3753	.03075	.3294
50		.040	.040	.1074	.129	2.685	.3621	.01455	.3681
51		.051	.051	.1360	.162	2.666	.3672	.01834	.3672
52		.064	.064	.1693	.199	2.646	.3732	.02270	.3662
53	1.375	.072	.090	.1889	.222	2.605	.3781	.02533	.3662
54		.081	.101	.2113	.249	2.608	.3824	.02823	.3655
55		.091	.116	.2357	.290	2.592	.3875	.03137	.3649
56		.102	.153	.2612	.314	2.574	.3943	.03474	.3647
57		.125	.187	.3147	.394	2.519	.4063	.04151	.3632
58		.051	.051	.1487	.158	2.916	.3984	.02392	.4010
59		.064	.064	.1853	.218	2.895	.4045	.02964	.4000
60		.072	.090	.2069	.243	2.875	.4093	.03310	.3999
61	1.500	.081	.101	.2315	.284	2.858	.4136	.03691	.3993
62		.091	.116	.2584	.318	2.842	.4187	.04106	.3986
63		.102	.153	.2867	.355	2.824	.4256	.04553	.3985
64		.125	.187	.3460	.431	2.769	.4374	.05452	.3969
65		.051	.051	.1615	.192	3.166	.4297	.03052	.4348
66		.064	.064	.2013	.237	3.145	.4357	.03786	.4337
67		.072	.090	.2249	.265	3.125	.4405	.04230	.4337
68	1.625	.081	.101	.2518	.273	3.108	.4448	.04721	.4330
69		.091	.116	.2812	.345	3.092	.4498	.05257	.4324
70		.102	.153	.3122	.386	3.074	.4567	.05834	.4323
71		.125	.187	.3772	.470	3.019	.4684	.06999	.4307
72		.051	.051	.1742	.210	3.416	.4609	.03834	.4685
73		.064	.064	.2173	.256	3.395	.4669	.04748	.4675
74		.072	.090	.2429	.287	3.375	.4717	.05308	.4674
75	1.750	.081	.101	.2720	.322	3.358	.4760	.05927	.4668
76		.091	.116	.3039	.371	3.342	.4810	.06604	.4662
77		.102	.153	.3377	.416	3.324	.4879	.07335	.4661
78		.125	.187	.4085	.507	3.269	.4995	.08814	.4645
79		.051	.051	.1870	.227	3.666	.4921	.04717	.5023
80		.064	.064	.2333	.276	3.645	.4981	.05861	.5012
81		.072	.090	.2609	.308	3.625	.5029	.06555	.5012
82	1.875	.081	.101	.2923	.344	3.608	.5072	.07323	.5006
83		.091	.116	.3267	.400	3.592	.5122	.08164	.4999
84		.102	.153	.3632	.446	3.574	.5190	.09074	.4998
85		.125	.187	.4397	.544	3.519	.5307	.10919	.4983
86		.051	.051	.1997	.241	3.916	.5234	.05738	.5360
87		.064	.064	.2493	.295	3.895	.5294	.07134	.5350
88		.072	.090	.2789	.330	3.875	.5341	.07983	.5350
89	2.000	.081	.101	.3125	.368	3.858	.5385	.08922	.5343
90		.091	.116	.3494	.415	3.842	.5434	.09957	.5337
91		.102	.153	.3887	.478	3.824	.5502	.11067	.5336
92		.125	.187	.4710	.582	3.769	.5618	.13334	.5321

Side Slips

Now I know why they have bombsights on helicopters," writes a friend, and his evidence is the following news item: "The undertaking firm of Shannon, Shannon and Shannon, Dallas, Texas, with great plans for the postwar world, has asked permission to operate a helicopter ambulance and hearse service. S S & S would pick up business within a 600-mi radius of Dallas and drop it with speed, mobility and comfort' at any hospital or cemetery in the U.S.A."

• Speaking of helicopters, want to ride in one? Here's one way to try, anyway: Two 15-yr.-old lads recently went fishing in a rented rowboat. One got off on a sand bar, the other took the boat and proceeded to get stuck in some nearby marshes, from which he was rescued by fishermen in a more or less conventional manner. His pal, however, spent several lonely hours on the sand bar until a Navy pilot spotted him and a helicopter was dispatched to effect the rescue, believed to be the first one. That historians may have the facts on this first, the pilot was Lt. (jg) W. C. Bolton of the Coast Guard, the rescuee was Harry E. Lundmark, of (as you might guess) Brooklyn.

•The pilot was very young, and very eager to get across and finish off the war. He'd pushed himself and the plane unmercifully. Even when they reached the jump-off base there was no let-up. The crew had barely completed fueling when he dashed from Operations with weather and clearance, the crew chief hadn't even slammed the door behind him as they taxied out, the very young and very eager pilot was so impatient that he pulled the wheels up just a shade too soon. The crew chief shuddered as he felt the prop tips take more than a good bite out of the runway, his teeth chattered in sympathy with the new vibration. But still the pilot kept pushing—right out over the drink toward war and real action.

Finally the chief could stand it no longer. he leaned over the pilot's shoulder and said, "Excuse me, sir, don't you think we should turn back and repair the damage?"

"To heck with it," the pilot replied, "let 'em fix their own runway."

• The field where the old timer kept his plane was often fogged in, but he didn't mind. His best friend's home was atop a hill—usually above the fog layer. The arrangement worked very nicely though—old timer would buzz the house, the friend would jump in his car with the spotlight pointed straight up and lead the way to a certain specified spot on the field and stop. Then the old timer would come in, all according to a well-practiced routine. The system was working beautifully one dusk until—the friend had a flat tire. Scrambling out to fix it as quickly as possible, he forgot to cut the spotlight; Old timer seeing it remaining stationary, came in for his usual half-blind landing. He walked away from the landing all right, but he had to crawl out from under a barn to do it.

• The furloughed officer, just returned via a big transport, was describing the crash landing they'd made in some very rugged country. "First," he said, "we lost the right outboard engine, then the left inboard went, then the right inboard—"

At which point the young lady cried, with some heat, "It's beyond me how you can admit it. With airplane engines as big as they are I just can't see how you could lose *one*, let alone mislay three!"

• It was a short-range ship, but the ferry pilot was trying to keep a tight schedule—fuel and get aloft again—even though his right landing gear was stuck in down position. After each takeoff, though, it meant long conversations with the control towers. Finally, when the 4th one called to report, "your right wheel is down, your right wheel is down," he replied wearily, "Yeah, I know, but I *like* to fly this way. Mind? Over and out."

• Seems we Americans are not the only ones who sometimes have trouble with words getting mixed up in transit. A delightful Englishman told us the other day, for example, that the British have recently changed one bit of their nomenclature. Seems that once during the dark days of the African campaign Air Ministry got a frantic wire saying 'send four air crews immediately." Four complete crews were dispatched forthwith, but weren't received with too much enthusiasm—for even though they were nice guys, they just couldn't be mounted on an engine to serve as airscrews

"Mr. Meguire thought that cute little Wasp would be his honey—but did he get stung!"

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB FOWELL, New York

Newly Strengthened Aero Chamber Posts 4-Point Program; Light Craft Future Ranged

Eased design regulations favored . . . Strength classes endorsed . . . News of air meetings . . . "Mustang" breaks transcontinental record . . . Small-airfield program wins favor . . . WTS planes on block

A reorganized Aeronautical Chamber of Commerce emerged with striking new vitality from a three-day joint session of its Directors and the National Aircraft War Production Council held in Los Angeles. And there came immediate announcement of a long-range four-point program designed to protect the United States and its aviation industry, meanwhile assuring the latter's future progress.

Authorized at the meeting was this resolution—

The United States should maintain an air power sufficient (in conjunction with other forces) not only to win this war but also to keep the peace: (1) By maintaining adequate air forces at such strength and in such state of readiness as to preclude a successful assault upon our country or its possessions; (2) by acquiring and maintaining air bases essential to our security and that of overseas trade; (3) by facilitating the orderly and economic expansion of domestic and international air transport and of private flying; and (4) by preserving a strong aircraft manufacturing industry.

Although it was stated by Eugene E. Wilson, Chairman of the Board of Executive Committee, that the "Aeronautical Chamber is an educational organization," announcement of East and West coast committees to solve 'commercial" problems indicated a campaign will be waged to convert the resolution into national policy.

To Handle Peace Problems

When asked if the Chamber would use present AWPC staffs in its educational program, Chairman Wilson said the body expects to use "all tools at its disposal." This question apparently sought to probe rumors that the National AWPC would if necessary, become the airframe manufacturers' association after the war. As indicated by Chairman Wilson, the postwar problems will be handled by the Chamber NAWPC, meanwhile will continue to handle war production problems.

The two committees for implementing the resolution for adoption as national policy are composed as follows: East Coast—R. E. Gillmor, chairman, Glenn L. Martin, J. Carlton Ward, Jr., Victor Emanuel, Allen Marchev, E. R. Breech, L. D. Bell, Eugene E. Wilson and C. J. Brukner. West Coast—Harry Woodhead, chairman, J. H. Kindelberger, Robert E. Gross, Donald Douglas, T. Claude Ryan, LaMotte T. Cohu, and P. G. Johnson. First duties are seen as advice to Congress on pending legislation dealing with termination of war contracts, with disposition of government-owned aircraft plants and equipment in private plants, and with a program for the release of surplus military aircraft for conversion to civilian use.

First day of the sessions saw the following National AWPC officers named: President, Victor Emanuel; Vice President, J. H. Kindelberger; Directors, Donald Douglas, P. G. Johnson, L. C. Goad, and Alfred Marchev. Then later meetings considered such problems as manpower, employment after the war, and also the current "strategic" and "production" schedules on planes, it being noted that the curve of planes needed for specific operations and the curve of aircraft availability had come together for the first time.

The chamber, at this writing, is considering several experienced executives for appointment to the important post of general manager. This official will face difficult and continuous problems.

Industry leaders sparked revitalization of Aeronautical Chamber of Commerce. Among them were (standing, left to right,) Alfred Marchev (Republic), J. Carlton Ward, Jr. (Fairchild), Glenn L. Martin (Martin), T. Claude Ryan (Ryan), Lawrence D. Bell (Bell), Robert E. Gross (Lockheed), Eugene E. Wilson (United Aircraft), and Ernest R. Breech (Bendix). Seen seated at table are J. H. Kindelberger (North American), P. G. Johnson (Boeing), L. C. Goad (Eastern Aircraft of GM), Harry Woodhead (Consolidated Vultee), LaMotte T. Cohu (Northrop), and Guy W. Vaughn (Curtiss-Wright).

Coming Up

June 5-7 Society of Automotive Engineers National War Material Meeting, Book-Cadillac Hotel, Detroit.

July 10-12 American Association of Airport Executives Meeting, Hotel Sherman, Chicago.

July 17-18 Air Traffic Conference, Denver.

August 2-3 National Aeronautic Association Business Meeting, Denver.

October 5-7 Society of Automotive Engineers National Aircraft Engineering & Production Meeting, Engineering Display, Hotel Biltmore, Los Angeles, Calif.

November 15-18 Second annual Clinic of Domestic Aviation Planning, Oklahoma City, Okla.

December 4-6 Society of Automotive Engineers National Air Cargo Meeting, Hotel Knickerbocker, Chicago, Ill.

January 8-12 Society of Automotive Engineers Annual Meeting & Engineering Display, Book-Cadillac Hotel, Detroit, Mich.

Light Aircraft Future Projected at Detroit

Aircraft manufacturers, at their recent National Light Aircraft Meeting sponsored by the Institute of the Aeronautical Sciences in Detroit, discussed plans for a new era of personal flying after the war, indicating, (1) that the utility of light airplanes must be improved in every way possible; (2) that first-cost and cost of maintenance and fuel must be brought down; (3) that the small airfield program—to put fields at popular places where people gather—is necessary for the development of light plane travel and transportation; (4) that the government certification of pilots and airplanes must be simplified; (5) that aviation instruments and radio must be simplified and reduced in cost; (6) that the postwar market for light air-

planes will be much larger then recent conservative estimates, (7) that safety must be still further improved, even though fear is no longer a major obstacle in the way of airplane ownership.

Warner Favors Easing Of Design Regulations

With a record attendance of some 400 light plane men, 22 technical papers were read and discussed. Collating the trends expressed, Dr Edward P. Warner, CAB vice chairman urged relaxation of governmental regulation affecting design and construction of private aircraft.

Prime purpose of airworthiness regulations, he said were fourfold. First to insure uniform quality to enable the user to count on the craft's measuring up to standards of performance for the type; second, to insure that planes have no features—either of inclusion or omission—which would lead to collision either on the ground or in the air; third, to develop full information on aerodynamic and structural qualities and general behavior of new types with such information being made available for the user's guidance, and fourth to make sure aircraft have no characteristics which would create hazards beyond the power of the pilot's skill to overcome.

Dr Warner presenting his personal views did, however urge tightening of regulations insofar as visibility for the pilot is concerned.

Endaras Civil Plans Strength Classes

Several other outstanding meetings marked the month. Convened in St Louis, the Airworthiness Requirements Committee of the ACCA endorsed recommendations that all civil aircraft be classified into specific categories for licensing and operational purposes, these categories to be divided into two groups—air carrier and non-air carrier. For the latter, there was tentative agreement on three strength classes: (1) Acrobatic, (2) training or utility, and (3) normal or personal transport; and for the former, the breakdown favored was: (1) air carrier passenger, (2) air carrier goods and (3) air carrier special purpose.

Exposition and Conference Mark Texas Program

In conjunction with Texas Aviation Week, the Southwest Aircraft & Accessories Exposition, sponsored by the Dallas Chamber of Commerce Aviation Committee, attracted several score exhibitors. There followed the Third Wartime Aviation Planning Conference at College Station, with A & M. C. of Texas and *Southern Flight* as hosts to training directors, relations personnel and representatives of airlines, schools, manufacturers and government agencies. Hundreds came from all parts of the country to partake in the discussions.

"EDDIE" ALLEN TUNNEL

Giant 16-blade hurricane-hurling fan—it can create nearly-sonic 700 mph winds—in new test tunnel recently dedicated as major installation at Boeing's Edmund T. Allen Memorial Aeronautical Laboratories at Seattle. Colossal blades, made of spruce, are 24 ft. dia., and will whirl at 490 rpm top speed, while huge hub fairing is of precise conical design to eliminate air turbulence. Tunnel will play leading part in program of progress so well advanced by the late "Eddie" Allen, internationally known test pilot and scientist. Builder of tunnel was the Austin Co., while synchronous electric motor was made by Westinghouse and regulatory magnetic coupling by Dynamatic Corp.

Oklahoma and Montana Hold Meetings

Principal speaker scheduled at the one-day Southwest Civil Aviation Forum held in Oklahoma City at press time, was Charles I. Stanton, CAA administrator. Informal discussions aimed to answer questions on Southwest aviation problems were the order of the day. Also being held as this was written was the Great Falls, Mon., "aviation clinic." This meeting was to assist regional communities and cities in preparing for postwar aviation development, especially in regard to feeder lines.

"Mustang" Flies Continent In 6 hr. 31½ Min

Two battlefront-bound North American P-51 "Mustangs" broke the transcontinental speed record on May 11, the time for the first ship being 6 hr 31½ min and for the second 6 hr 36½ min. Respective average flying speeds were 373.54 mph and 370.2 mph. The planes, it was stated were fully equipped craft "fresh from the NAA production lines." Extra long-range gas tanks were employed.

Both P-51s made the identical 2,464-mi. Los Angeles to New York run. However Col. Clair Peterson, pilot who made the fastest time, carried an initially lighter gas load and made one stop for re-fueling at Kansas City. Col. Jack H. Carter, clocked 6 min. slower, came through non-stop.

Small-Airfield Program Wins Wide Appraval

The program for the building of small-airfields, undertaken by the Personal Plane Department of the ACCA has approval of the light plane industry, of the Civil Aeronautics Authority, and of many publications, communities, and pilots everywhere. The small-field program does not, as yet have any government aid, communities are merely encouraged and instructed in establishing them. Neither is there any so-called "flight-strip" program, except that already carried out by the Bureau of Public Roads, which has completed 26 strips. CAA has appropriations to build only Class 1, 2, 3, and 4 airports.

The proposed small airfields are not expected to entail a high cost for respective communities; it is believed they will employ many returning service pilots and crewmen as instructors, taxi and fixed-base operators, and possibly fly-yourself services.

Certain leaders among them some CAA officials decline to support the proposals for flight strips which are presumed to be landing facilities alongside a highway. Opponents ask why anyone would want to land by a highway until such time as roadable planes might be used in large numbers.

WTS Planes on Block

By the time you read this, over 1,000 of the WTS planes recently declared surplus will have been sold to bidders. During the summer probably the entire 5,000 owned by Defense Plant Corporation and lent to WTS, will be offered.

Some manufacturers have complained that this sale is depleting their prospective postwar market. Government's answer is that taxpayers' would complain still louder if their money is not salvaged insofar as possible.

★ SPOT CHECKING ★

A high mark of month was great candidness with which Materiel Command, Wright Field, took members of Aviation Writers Assn. into its confidence on current striking aircraft developments and the even more striking developments which are to come.

Writers came away amazed at our present and future skylighting power revealed in terms of warplanes, guns, rocket weapons, engines both jet and reciprocating, bomb sights, radio location devices and 101 other things all sparked by new speeds, climbs and ceilings. It can be stated that they saw Bell's jet plane fly; also the Sikorsky helicopter; were given various radio-location demonstrations, looked through Norden and Sperry bomb sights, watched tests of a new wing and engine in the huge wind tunnel, and viewed Boeing's Superfortress', Northrop's new "Black Widow," Douglas new flash bombers and various other experimental craft.

Following their Patterson and Wright Field visits AWA members were flown to Dallas, Tex., in Fleet Trooper Carrier Command C-47s, visited North American and Convair plants at Fort Worth, proceeded to College Station, Tex., for their annual convention in conjunction with the Texas Planning Conference, and finally were flown in Navy "Catalinas", to Corpus Christi for a tour of the Navy base. AWA elections: George Haddaway, president; Maurice Roddy and Philip Andrews, vice-presidents; Leslie Spencer, treasurer; Devon Francis, executive secretary; and Retiring Pres. Wayne Parrish, governor-at-large.

Torpedo Squadron 8

NO. 8 OF A SERIES HIGHLIGHTS OF WORLD WAR II PRESENTED BY TUEX TOOLING (INC.) LOUISVILLE KY SEE OTHER SIDE

BY JAMES H. SESSIONS

Plan for a single unified command over land, sea and air forces has won additional support from high officers in Washington, but concensus is that activation of such a program must await close of war.

Over the last three years more than 80 000 U. S. planes—roughly 1/5 of our production—were sent to our Allies. Lend-lease accounted for some 28 000 with remainder purchased for cash. In addition $1 480 000 000 worth of engines and parts have been shipped also hundreds of millions of gallons of aviation fuel.

Reorganization of Materiel Command's Inspection division is announced aim being speedier clearances with highest possible margin of safety of our flying equipment. Accordingly, procedures will be afforted in every war plant making aviation material. Coincidentally Col. Bryant L. Boatner was named inspection division chief.

G & A Aircraft Co., Firestone subsidiary, has presented a jump-takeoff autogiro to Princeton's aeronautical engineering department. The craft will be used as a flying laboratory for rotary wing research.

★ CALLING NAMES ★

John L. P. Brodie and **Hugh Burkinghem** have been appointed directors of the deHavilland Engine Co. Ltd., in addition to the existing directors. Mr. Brodie becomes director in charge of the engineering division and Mr. Cocktingham business director.

Harold J. Roig, president and director of Fairchild, has been re-elected and **Howard B. Dean**, who has been re-elected as a director, has also been made v.p. **Henry Friendly** has been chosen director in place of **George L. Rihl** and **Erwin Gallinder** succeeds **E. E. Yeung**.

United Air Lines announces that **Homer J. Marchant**, is now acting eastern sales manager and **S. R. Newman** acting western sales manager. **Warren D. "Bill" Williams** is superintendent of western flight operations. **Harold L. Knoop** eastern flight operations and **Paul Reeder**, Pacific flight operations. **M. S. "Mirkey" Crawford** returns as equipment engineer after serving for two years as field manager for Peru. **Prodnrte Melvin T. Broekman** is named manager of air-truck service for the air cargo department. **S. V. Hall** is assigned as full-time manager of military operations for the ATC across Pacific. **Capt. Virgil W. Vaughan** has completed his 1 500th hr. of overseas flying for the ATC. **R. C. Wright** has been appointed assistant treasurer.

Mario Molina has joined TACA Airways Agency as traffic representative for the N. Y. office.

Wilbert Fred Calliett was appointed general auditor for American Airlines.

Capt. C. W. "Chuck" Weihlen, PCA chief pilot, has been appointed to the newly created position of System Chief Pilot. **E. E. Hertzler** has been appointed chief industrial engineer of Consolidated Vultee's Miami division transferring from San Diego and replacing **Quentin G. Turner** who goes to San Diego as asst. chief industrial engineer. **Major E. A. Levinson** is now Army contracting officer for the Ft. Worth division.

William P. Gwinn was elected general manager of the engine division of United Aircraft.

Wilford J. Kamerer, supt. of the Norwich, Conn. plant of Hamilton Standard Propeller division of United Aircraft, transfers to the main plant at E. Hartford as staff asst. in the office of the general superintendent. **Carl A. Kranse**, plant engr. at Westerly, R. I., takes on the added duties of the Norwich plant. **Carl F. Schory**, service manager at E. Hartford, has received his 15-yr. pin. **Thomas A. Dicks**, "daddy" of the propellers, an engineering consultant for Hamilton Standard, recently celebrated his 84th birthday.

Charles F. Silck, formerly general factory manager, Fairchild Aircraft division at Hagerstown, has been made asst. works manager. **Louis Fahnestock** continues as works manager. **John Young** heads a new division of the production department known as production engineering. **E. L. Buchanon** heads the manufacturing division of production as general factory supt.

Orville Wright, famed aviation pioneer and one of the original members of the Aeronautical Chamber of Commerce when the national group was organized in 1921, has been elected to honorary life membership in the Chamber. **C. E. Wilson**, vice chairman of United Aircraft Corp., was elected chairman of the Chamber's board of governors and **Donald W. Douglas**, president of Douglas Aircraft Co., vice chairman. Other elected officers included **James P. Murray**, v.p. Boeing Aircraft, president; **Lawrence D. Bell**, president of Bell Aircraft, and **LaMotte T. Cohu**, chairman of Northrop Aircraft, vice-presidents. **John E. P. Morgan**, treasurer, and **Col. Harrison Brand, Jr.**, secretary.

Robert G. Owens joins Zephyr Mfg. as general manager.

Frank C. Dyer, supt. of communications for Braniff at Dallas, has assumed charge of preparations for the operation of Aerovias Braniff, S.A.

Lt. Col. Robert L. Baseler has been awarded the Silver Star. While leading his group of P-47 Thunderbolt fighter-bombers over Italy, his group destroyed 38 enemy fighters and severely damaged 6—all in 20 min.

Capt. Howard Cone, who was commander of Dixie Clipper on President Roosevelt's trip to and from the Casablanca Conference, recently marked the completion of 10 yr. of intercontinental flying with PAA. **Capt. William A. Winston** completed 100 crossings of the Atlantic as commanding officer of the transatlantic Clipper. **William E. "Pop" Smith**, 15 yr. veteran of Pan American intercontinent maintenance problems, was honored by a party attended by 500 fellow employees. **Robert C. Hallett** was named asst. division traffic manager of the Atlantic division with offices at LaGuardia.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

As engineer told us that jet-powered airframes, minus the weight and vibration of rotating engines, will last two or three times the present 10-15 yr. life of conventional planes. And the jet engines themselves with very few rotating parts, may some day last as long as the airframes—an even greater economy. When and if such durability becomes common, manufacturers will have to slope the hood a different way each year and figure out some knee-action come-ons.

Standard world-wide airworthiness regulations will be the subject of long debate. It has taken years to reach a semblance of agreement in this country alone. Nations might never agree. Even if they did, some think we would thus be helping cheap-labor countries with inferior engineering ability to compete against us.

Some experts are amazed that Germany could take so much bomb demolition so long and not show more weakness. They say that aviation has actually done almost the expected damage. At the same time, they admit that air bombs on the average, are at low velocity on contact compared with large shells and that accordingly they are limited in penetrating power.

Prestige of CAB is on the steady upgrade because of its constant hard work and its studied impartiality. Air representatives of several foreign governments have been here taking notes on CAB organization and procedure. Authority of the Board is nevertheless threatened by world importance of aviation and the temptation of big-league politicians to take it over.

GOAL: BETTER FIGHTING PLANES

Means to improve military effectiveness of combat aircraft was topic when NACA members conferred recently with Army and Navy leaders in Washington. In foreground are William Littlewood (left) and Dr. Theodore Wright; and at table (left to right) are: Dr. William Durand, Maj. Gen. Echols, Dr. Vannevar Bush, Vice Adm. McCain, Maj. Gen. Giles, Dr. Orville Wright, Dr. George Lewis, Dr. Jerome Hunsaker, John Victory, Dr. Charles Abbot, Dr. Edward Warner, Dr. Lyman Briggs, Rear Adm. Pace, Hon. William Burden, and Dr. Francis Reichelderfer. Jet propulsion was one of the subjects discussed.

NATION'S CAP WING COMMANDERS GATHER

With 47 states represented by Wing Commanders the Civil Air Patrol closed its recent two day meeting in New York City with this dinner at Waldorf Astoria Host was Maj William P. Leer, CAP Communications Director and President of Leer Aviation. Among honor guests were Maj Gen Robert W Harper, Deputy Chief of Staff Air Training; Lt. Col. Earle L. Johnson, CAP National Commander; and Thomas Beik, Crowell-Collier Publishing Co chief. Gen Harper stressed the General Staff's long term regard for CAP, said Patrol would play an even more important role in coming peace.

Field, and he will assist division traffic manager **Phil S Delauy**. **Donald O Q Lemagland** was named senior staff engineer at the Intercontinental terminal. **Talbert A Rice** was named district manager for the United Kingdom and Eire, with headquarters in London, and **A Jackson Kelly**, district traffic manager and senior representative of the airline in the British capital, now furloughed home after two years abroad, will be assigned to division headquarters at LaGuardia Field upon completion of his vacation.

Douglas Aircraft announces the **Herman O Olsen** has been named asst superintendent of assembly in the 42nd plant. **W G Jerrems** is named manager of the Tulsa, Okla, plant. **Jack A. Hendley**, plant engineer of the Long Beach plant, now is in charge of maintenance and construction of the numerous feeder shops. **Lee J Robinson** is appointed sales division head for industrial and public relations at Oklahoma City. **Howard F. Meginnis**, formerly with the Tulsa, Okla, *Tribune*, becomes A. M. Rochlen's representative for the industrial and public relations departments at Tulsa. **Tom H. Brennan** is now properties manager of plant layout, equipment and machinery control, industrial engineering and methods at Santa Monica. **E N Clessen, Jr.**, is now asst. superintendent of fabrication.

George F. Lewin was appointed assistant to Harry R. Brubaker, manager of the traffic department of the ACC.

George P. Torrence assumed the presidency of Cleveland Pneumatic Tool and its subsidiary Cleveland Pneumatic Aerol, Inc and concurrently **Daniel C Green** was elected board chairman of both companies.

Jack Frye, TWA president, was elected a fellow of the Institute of the Aeronautical Sciences. **Russell G Pettile** district traffic manager in St. Louis since 1938, was appointed asst to **W. W. Coyle**, midwest traffic manager. **John D. Thomas**, N Y. reservations manager, transfers to St. Louis to succeed Pettile and **W. J. MacDonald, Jr.**, chief reservations control representative in N.Y., was named to Thomas former post.

William A. Coulter, was re-elected president and chairman of the Board of Western Air Lines at the annual stockholders' meeting. **L. H. Dwerlkotte**, vice-president, **Harold P. Fabian**, **Stanley W. Guthrie**, and **George A. Smith** were re-elected directors and at a meeting following the stockholders session Mr Dwerlkotte was elected executive v-p. **Charles N. James**, v-p. operations. **Thos. Welle**, v-p. traffic. **Paul E. Sullivan**, secy-treas. and **J. J. Tayler**, asst secy.-treas.

Ernest G Steut, design chief engineer for Consolidated Vultee and winner of the Lawrence Sperry Award has been elected an associate fellow in the Institute of the Aeronautical Sciences.

L. S Randell, past president of the Advertising Club of N. Y. and past president of the Sales Executives Club of N. Y. has joined Bressler Editorial Corporation as v-p and sales manager.

AMERICA AT WAR

Aviation's Commaslque No. 30.

Continuous and steadily mounting air attacks through late spring in preparation for the actual land invasion meant that the Allies had finally built up their long-sought air power margin. Magnitude of the production phase of this task, already accomplished, is implied in the Army-Navy production program for the rest of this year, in which 36 percent of the total is aircraft.

In Sept 1940, the Luftwaffe loosed nearly 10 000 tons of bombs on England. Never again did it reach that rate of delivery. In the one month of Apr 1944, British and American air forces dropped nearly 100 000 tons of incendiaries and explosives on Hitler's targets. This is more than Goering's total of missiles unloaded on England in this war to date.

About 45 000 tons of the April deliveries on Europe were by American forces based in England and Italy. American losses were 537 bombers, less than 3 percent of participants and 191 fighters, just above 1 percent.

The power of both RAF and AAF is such that each can send out forces of 1 000 heavies day after day. American daylight attacks being supported by about 1 000 fighters. Greater forces are feasible on occasion. In two days the AAF sent 4 000 bombing sorties over Europe and shot down 112 Nazi planes in the bargain. Largest RAF force according to press reports, was 1 100 heavies up to this writing. In one recent 30-hr. period, 6 500 Allied planes unloaded bombs on Nazi-held Europe.

American planes used in greatest numbers against the Germans are the Boeing B-17 *Flying Fortress*, the Consolidated B-24 *Liberator*, Republic P-47 *Thunderbolt*, North American P-51 *Mustang*, Lockheed P-38 *Lightning*, and the Martin B-26 *Marauder*, this latter reported attacking in "swarms." The British de Havilland *Mosquito*, depending on speed for defense seems to be an institution in itself.

In the Pacific, the Navy's sphere of air control is expanding from captured islands and new air bases closer and closer to Japan. Naval forces with carriers so numerous that twelve of them recently showed in a picture of one harbor are so great that the Jap fleet has been entirely withdrawn.

As the Japs back closer to their home grounds their supply lines shorten, to their advantage. The Allies, with vastly greater strength, are following them in to practical bombing bases. Some day the air attack will begin from the Kurile Islands (which Secretary Knox said, a few days before he died, that we would take) from islands southward, from the shores of China, or from our carriers—or all four. But Japan is moving war production into Korea and Manchuria, and war commanders are preparing for land action in the Orient, as in Europe.

Consolidated *Liberators* recently flew a 2 000-mi round trip to an effective attack on an island called Satawan, such trips are rapidly becoming commonplace. Adding to the Jap's woes, the Navy is using new rocket throwers. And a new version of the Grumman F4F, the FM-2 built by Eastern Aircraft, has more power, less weight, more speed, and improved performance.

The impressive showing made by airpower in this war, though it has not met the expectations of optimists has finally won enough converts so that the Congressional Woodrum Committee on Postwar Military Policy is giving most of its attention to the air phase of national defense. This committee will blueprint the size of military forces to be maintained in peacetime depending upon the kind and extent of peace.

Obituary

Mrs Florence Shloss Guggenheim, widow of late Daniel Guggenheim, who established Daniel Guggenheim School of Aeronautics at New York University and Daniel Guggenheim Fund for promotion of aeronautics. In turn, Fund endowed schools of aeronautics or professorships at Massachusetts Institute of Technology, Georgia School of Technology, California Institute of Technology, University of Washington, Leland Stanford, Syracuse University, and University of Michigan, also donated $250,000 for establishment of Airship Institute at Akron. In 1942, as a memorial to her husband Mrs. Guggenheim made a gift of her Port Washington, L. I. estate for establishment of a center for aeronautical research and study to be undertaken through the Institute of the Aeronautical Sciences.

A. Leo Stevens, pioneer credited with numerous parachute developments and early lighter-than-air man. He made more than 3,400 balloon ascensions and a dirigible built by him made its first successful flight in 1932. A member of various balloon clubs and an honorary member of the Aeronautical Society of America, he was working with the Switlik Parachute Co. at the time of his death.

William Thomas Miller, chief of Air Carrier Div. CAA since 1938. Previously he had served as a lieutenant commander in Navy and was credited with making an aerial survey of South Pacific for Navy from 1936 to 1937.

Senate Committee Okays Bill on Contract Settlements; 8,343 Planes Made in April

Postwar designing gets AFB "go ahead"... Buick tools for new P. & W.'s... Boeing reports greatest year... K. C. plant turning out high-power P. & W.'s... Surplus War Property body in action

Senate Military Affairs Committee recently approved a bill providing for creation of an independent office of contract settlement which would be headed by a director to be appointed by the President. Subcontractors would be included in prime contra 'ors' claims for settlements. Contractors would be financed within 30 days after they file application, pending settlement. Government would be required to move its machinery out of private plants within a period of 60 days.

Court of Claims would be final arbiter, and authority of the General Accounting Office would be limited to cases of fraud.

April Output 8,343 Planes, 96 Million Pounds

Aircraft production dropped back to 8,343 planes in April, somewhat below the output of 8,362 in Oct. 1943. Production in poundage also fell off 8 percent (from the 103.4 million-pound record set in March) to 96 million. C. E. Wilson, chairman of the Aircraft Production Board, explaining the decline, said April had only 25 working days, but mainly it was due to increasing emphasis on needed combat types which constituted 77 percent of the total in April, a new high.

Wilson stated the industry is doing a good job but the continued shift to longer-range types and constant improvements based on battle experience will call for continued maximum effort. West Coast AWPC calls attention to constantly increasing speed, higher ceilings, and better armament, all of which takes more hours of work.

Postwar Designing Gets AFB "Go Ahead"

Dr. A. E. Lombard speaking for the WPB Aircraft Production Board, told the industry recently that it is free to go ahead with development of postwar aircraft and any other product designs. Lombard said this relaxation is possible because the industry has hit its peak output. He cited WPB Order No. P-43 of Mar. 5 permitting laboratories to obtain materials and build prototype articles for manufacture after the war.

Buick Tools for New P-W's

GM's Buick Div. is tooling to make two additional types of P. & W. engines for Consolidated B-25's and Douglas C-54's. Both are twin-row *Wasps*, R-1830-75 and R-2000-9, of different dimensions and developing greater horsepower than current types. Buick has an AAF contract for engines totaling more than $60,000,000. Stand-in machinery is being placed in the plants for production of the new power plants while present equipment continues turning out current types for B-24's and Douglas C-47's.

Boeing Reports "Greatest Year of Achievement"

In Boeing's annual report, Pres. P. G. Johnson refers to 1943 as Boeing's "greatest year of achievement." He says requirements of the Army Air Forces for both B-17's and *Kaydet* trainers have been met. Production deliveries of the B-29 *Superfortress* has begun in two of the company's divisions at Wichita and at Renton, Wash. The Seattle Div. now goes into process of conversion to B-29 production. This conversion will be accomplished gradually, with B-17 production decelerating while B-29 production is being accelerated. Mr. Johnson says 10,000 *Kaydets* have been built. He concludes that problems greater than those encountered in the war must be faced after the war, and that it may be necessary for the company to manufacture and market other products in addition to aircraft.

K. C. Plant Turning Out High Power P. & W.

Pratt & Whitney's new engine plant at Kansas City is turning out the new R-2800-C engine officially rated at more than 2,100 hp. The plant specifically designed and tooled to produce this particular engine, has a capacity of 3,000,000 hp. per month. About half of the ultimate work force of 29,000 have been employed. Of the 1600 parts that go into the R-2800-C, more than 600 are made at the K.C. plant. The plant is sponsored by the Navy, which does not however, have exclusive right to its output. It is government-financed and the P. & W. management has made an unprecedented agreement with the Navy to operate it without any remuneration.

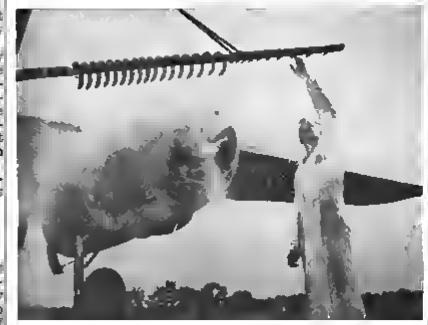
Surplus War Property Body In Action

A Surplus War Property Administration has been set up in Washington, and by the time you read this it will have issued Order No. 1. A subcommittee had been formed at this writing to deal with SWPA's most difficult problem—that of disposal of surplus airplanes and of surplus airfields. CAA Chairman W. Pogue is a member of the Surplus War Property Board.

Disposal of surplus warplanes will have an important effect on the aircraft industry. It is expected that the government will hold many planes to maintain strength of postwar airforces keep many as standby's, and otherwise avoid dumping enough of them on the market to seriously hurt the merchandising of new production. It is believed that only the transport planes, the light liaison planes, and perhaps a few trainers, will have any commercial value.

"Merlins" En Masse

A record breaking first-quarter production of Rolls-Royce *Merlin* aircraft engines (which power the North American P-51) is reported by Packard, which meanwhile notes that engineering changes on this two-stage two-speed supercharger engine, dictated by battlefront experience, have averaged 400 per month since production started. The company recalls that some manufacturers once considered the engine too complicated for volume consumption.



ICES BLADES—BUT FAST!

Air engineers of Propeller Div., Curtiss-Wright, Caldwell, N. J., working in cooperation with AAF Materiel Command, use this novel spray rig to spew water on bomber props during flight in order to make precise de-icing and anti-icing tests. Outrigger draws water from 400-gal. tank fitted in bomb bay. At high altitudes, spray ices on aircraft, then de-icing solution currently under study is tried out on surfaces of blades.

★ PLANE LINES ★

Convair's projected six-engine mid-wing monoplane the mammoth Model 37 transport for postwar, was recently shown in initial full scale wooden mockup form to members of the Aviation Writers Assn. visiting the Fort Worth plant. Features: Capacious double deck to carry as many as 400 passengers, huge flaps and reversible pitch props to brake landing speed. Is being of belly-wing type via plating. Fabrication with a new type alloy is planned. Certain of the components were reported already being turned out with some 10 major and 400 minor manufacturers seen contributing to the project. Gargantuan size of mockup amazed observers, led one to remark, "It's like a flying Holland Tunnel."

Meantime, reports came from Coast of first test flight of Convair's Model 32, postwar 48-passenger airliner (see page 215 May AVIATION for details of this plane).

Public got word of two new helicopters—two place Bell and craft developed by Aeronautical Products. Bell ship employs two-blade 33-ft.-dia. rotor and it is powered by vertically-mounted 180-hp. horizontally opposed Franklin aircooled engine. A stabilizing device is slated to render rotor independent (of mast) so that it

tends to retain a [illegible] plane

AAF's first center employs a three-blade 30-ft span rotor geared to a 115 hp aircooled engine which is mounted in craft's nose in conventional tractor style but later models will have power plant within cabin

Development is also announced of two new larger-size Sikorsky helicopters reported planned for production this year. Company is known to be working on a 14-place craft

Latest version of Douglas A-20 Havoc is stated to have double the fire power of earlier models with nine .50-cal guns mounted

Now highly armed North American B-25 is described as a "minimum altitude strafer and anti-personnel fragmentation bomber." It packs fourteen .50-cal guns plus a 75-mm cannon. This is model carrying brace of package guns on either side of cockpit

Also anticipated during month is new Grumman FM-2 "Wildcat," being produced by Eastern Aircraft Div. of GM at Linden, N. J. Features: Faster climb than original Wildcat, shorter takeoff and lower landing speed less weight despite use of a greater horsepower Wright engine (forged cylinder-head plant)

Republic "Thunderbolts" are now being delivered to Russia under lend-lease.

★ ASSEMBLY LINES ★

A Boeing Flying Fortress has established what is believed to be a new AAF service record flying 330 hr. 20 min. in a single month

Kelley-Koett airframe parts maker, operating two plants, has increased production more than one-third in 1943 compared to 1942.

Chance Vought Aircraft Div. of United completed construction of its 9,000th F4U-1 Corsair fighter plane

United Nations are now producing 400,000 barrels of 100-octane gas per day

First-quarter poundage output of the Pacific Coast AWPC aircraft plants, excluding spares, was 90.7 ahead of the same period last year and exceeded the first three months of 1941 by 1,837 percent. April airframe poundage was 30.8 million, comparing with 26 million in the March peak and 24.4 million in April of '43

Goodyear Aircraft Corp. will make tail surfaces for Army P-38 "Lightning" fighters

Hamilton Standard has been awarded a certificate of merit by the insurance companies for its low mark of 7.2 lost-time accidents per million man-hours

Allison has completed its 60,000th engine, raising total hp produced to 60,000,000

Sixty key employees of The Austin Co. have been cited by the Navy for meritorious civilian service.

At Seattle on May 12, the 5,000th Boeing Flying Fortress came off the line. Meantime, as B-29 work proceeds, special trucks have been built to haul the larger "Superfortress" assemblies from the Seattle plant to Renton, a special [illegible] outlined from the state to run the big trailers over the highways.

Cleveland Pneumatic Tool Co., landing gear maker, celebrates its 40th anniversary this month

Revised bulletin ANC-19 "Wood Aircraft Inspection and Publication" will shortly be available from the Government Printing Office

Removal is announced of the old 900 lb. quarterly limit on the use of new aluminum in the manufacture of new patterns according to a WPB release

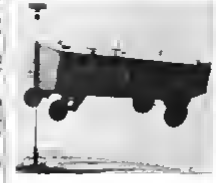
Glenn L. Martin's engineering department has developed a new droppable sponson fuel tank for increasing range of PBM-3 "Mariner" by 60 percent with no appreciable effect on performance characteristics other than a 2 percent reduction in top speed. Designed by John D. Pierson, it is reported to overcome limiting factor of former auxiliary gasoline tanks by providing added planing area to compensate for the additional fuel weight

A new aircraft starter that cranks 2,000 hp aircraft engines, yet weighs only 32 lb., is reported by Philadelphia Div. of Bendix. Fly wheel of starter weighs only 5 lb., but spun by an electric motor to a speed of 28,000 rpm., it delivers a punch of more than 1,300 ft./lb. Flywheel can also be cranked by hand should battery power fail or in event there are no facilities for battery charging. The starter is already in use on the fighting fronts

Ranger of Fairchild has obtained three new war contracts for material for combat planes through AAF Materiel Command. Contracts made with Packard Motor Car, Continental Motors, and Andover Motors will make necessary a threefold increase in personnel

A research project to obtain fundamental data on high speed milling has been established at California Institute of Technology under contract with WPB through Office of Production Research & Development. Project was recommended by AWPC and by Manufacturing Engineering Committee of ASME

Successful flight tests of an Army basic training plane equipped with a glass-reinforced plastic fuselage sides, panels, and tail cone have been made, following a research program initiated by AAF Materiel Command to develop high strength plastic structural materials for aircraft construction use



THAR SHE FLIES!

A steel tank on wheels "Flying Flossie" as she's called is rated as a key piece of aero equipment aboard British battleships. Specifically, the Royal Navy uses her to test the trim and punch of aircraft catapults. Nominated for a ride is "Flossie's" Herr A. Hitler. (International News Photo)

PRODUCTION-BATTLE CITATIONS

★ Four Stars ★

Lodge & Shipley Machine Tool Co
Electric Storage Battery Co

★ Two Stars ★

Mack Trucks (3 plants)
I. F. Laucks
The Thomas & Betts Co
Victor Equipment Co
Sprague Electric Co
Aro Equipment Corp. (Bryan, Ohio plant)
Aluminum Industries

★ One Star ★

Champion Spark Plug Co
Aro Equipment Corp. (Cleveland plant)
Briggs Clarifier Co
Westinghouse Elec. & Mfg. Co. (4 plants)

Army-Navy "E"

Cincinnati Industries
Western Automatic Machine Screw Co.
Posey Mfg. Co.
Langley Corp.
Superior Tube Co.
Scintilla Magneto Div., Bendix Aviation Corp.
Link-Belt Co. (Pacific Division)
Clarke Aero Hydraulics

★ FOR THE RECORD ★

Sprague Specialties Co. has changed its name to Sprague Electric Co.

Thermex Div., Girdler Corp., Louisville, announces opening of a New York office, with Hugh Cameron as eastern representative.

The Bristol Co., Waterbury, Conn., announces opening of a new Cleveland office.

Douglas Aircraft Co.'s Chicago plant will have three new factories, approximately $400,000 having been approved for immediate construction.

Glenn L. Martin's new flying boat hangar, capable of holding a JRM Mars or 3 PBM Mariner flying boats is nearing completion at new Strawberry Point seaplane base. Hanger is of permanent steel construction with 200 ft. clear doors at either end. A two story structure at one side will be used for office and storage space.

Felt Products Mfg. has acquired another new factory building in Chicago.

Jacobs Aircraft Engine Co. at Pottstown has constructed a new windowless 21 acre plant.

National Aviation Supply Co., just formed in Pittsburgh, Pa., will carry a large stock of aviation supplies and equipment. Immediate propeller reconditioning services are offered.

The Aircraft Electrical Council, a subdivision of the National Electrical Mfrs. Assn., has been formed to provide more effective contact between aircraft and electrical manufacturing industries.

The Norden Laboratories Corp. has been formed with Carl Norden as president and with Theodore H. Barth president of Carl L. Norden Inc., as vice-president and treasurer. This new research and development organization will headquarter in New York City.

Yale & Towne Mfg. Co., New York City, has purchased the scale business of the Kron Co., Bridgeport, Conn.

Midwest Aircraft Sales Corp., light plane distributor, has retained Aviation Associates, Chicago, to make a detailed market analysis of the area which it will serve.

Goodyear Tire & Rubber Co. has created a plastics and chemical sales division. It will be headed by Herman R. Thies.

Bellard Aircraft recently opened a new service office at Atlanta, Ga., to provide quick response on service calls.

Southeastern Air Service, Inc., is new name of Georgia Air Service.

★ KNOW-HOWS ★

Douglas Aircraft's El Segundo supervisor, S. H. Phillips, has developed a light-weight, compressed-air expanded type plastic rivet for joining plastics together with sheet metal. In addition to weight saving, it is stated to afford new man hour economy; also optional coloring to match material being riveted.

Glenn L. Martin's new "Flight Floor", a sprayable Thiokol-ground cork floor compound resistant to fire and usual corrosives, is being used extensively on Mariners, Marauders, and Baltimores instead of rubber matting, with a saving of over 150 grams/sq.ft. in weight as applied. It is reported very little wear was shown by the samples exposed to passage of more than 100,000 people, also that this floor finish does not become slippery when wet.

The same firm reports development of a mechanical draftsman for the trimetric projection process, giving three dimensional drawings with a minimum of perspective distortion at a cost permitting use for shop or advertising work. The new device, known as the Martin Axonograph, combines with a camera, the necessary electrical and mechanical movements for creating shop illustrations under the system.

Chips, which formerly required one man's full time at Martin's to remove from milling machines, are now blown clear as made, the process being performed by twin air jets delivering into a box beside the machine. Additional advantage is automatic scrap separation at source, abolishing former time-wasting separation after all waste metal was collected.

Robert A. Weaver, of New York, announces development of a new porcelain enamel, tough light, and highly heat-resistant which may be used as an exhaust stack finish to add to engine efficiency by reducing exhaust drag.

Bendix reports a plastic substitute for human hair in weather instruments, developed by Friez Instrument Div. An electric hygrometer strip, it is now being used in ray sondes.

Prospects Better for Return of Planes To Airlines; Air Law Battle Slacks Off

Notes on international transport meetings . . . Matson still presses for Hawaii service . . . international group plans Atlantic operations . . . Traffic is broad gain . . . Route applications . . . Re-use rationing

With good chances of getting back most or all of their requisitioned airplanes and with their pilot situation improved by termination of the CAA-War Training Service, many air transport leaders find things in better shape now and, furthermore, see improved prospects for the future.

Army is negotiating with the airlines for return of about 24 more planes this spring. That will leave in possession of the Army 100 more which observers believe will be back in private service before the end of autumn. Many of the planes—mostly Douglas DC-3's and some Boeing 247's and Lockheed 10's—were purchased outright by the Army, while some were leased. Establishment of a price basis for sale back to the airlines may serve as a precedent for terms under which war surplus transport planes will later be disposed.

Air Law Battle Slackens; Big Fight Postponed

So complete was the failure during recent months of efforts to revise the civil air law that the battle now is behind the scenes. Railroads and shipping lines are maneuvering for the big fight when it does come, probably not this year. Department of Justice, Civil Aeronautics Board, and many congressmen are against joint management of air and ground services. Canada's new Air Transport Board is being set up with machinery to break down the domination of airlines by the railroads in that country. In England the question of steamship participation in aviation is still an open one. Both the Lea bill and the newer McCarran bill appear to be dormant on Capitol Hill.

Notes on International Transport Meetings

Though new American-flag foreign services will carry but small traffic compared with domestic system loads, the airline managements anxiously await decisions that will determine their off-shore futures. The governments of the United States and Britain, by far the biggest world operators, continued their meetings in England and in Canada toward laying the foundation of a world plan. Lord Beaverbrook, Under Secretary of State Adolf Berle and E. P. Warner, vice chairman of CAB, reached preliminary understanding as to the degree of control government should exercise over international operations leaving the mechanics of control for future study. They agreed that subsidies should not be used competitively but only to keep in operation non-paying routes of national importance. It was taken for granted that Germany and Japan should not be allowed to own and operate air transport services for a long time.

At this writing, representatives of the Russian government were awaited for a conference in Washington. Competent opinion in the Capital is that the full-dress United Nations conference cannot be held this year. Mr. Berle and other officials have said the question of sovereignty over lend-lease air bases after the war is of little importance. Meanwhile the airlines are awaiting information as to what terms will be set up for the termination of their Transport Command contracts. (Also see "Abroad" news story, page 225.)

Matson Co. Still Presses For Hawaii Service

Matson Navigation Co. recently reiterated its determination to operate air services from West Coast cities to Hawaii, for which application was filed last September. Matson takes the position that the civil aeronautics law does not forbid air service in conjunction with its steamship service, or if it does, then the law should be changed. In 1935, say company officials, Matson invested $500,000 in Pan American stock, the money to be used toward financing facilities and equipment for the U.S.-Hawaii air service. CAB overruled the agreement which included also the use by PAA of Matson terminal facilities and meteorological information. Matson is reported to have sold most of the stock.

International Group Plans Atlantic Operations

"Important interests in Canada, United States and Great Britain" will join with a Newfoundland group in the establishment and operation of North Atlantic air services between the three countries, with base at Newfoundland, according to V. S. Bennett of St. John's, N.F. United States interests are headed by Smith, Barney & Co., investment bankers, New York, who say they have had a leading part in the financing of U. S. airlines. Company is surveying operating conditions and negotiating for rights of entry.

Discontinuing 23 Towers

Operation of 23 traffic control towers in 23 cities is being discontinued by CAA because the AAF has withdrawn funds allocated for that purpose. CAA took over the towers at request of the Army because of heavy military traffic in the regions involved. The Army Supply Act of 1941 authorized this service by CAA. There are 115 such towers (including those being eliminated). Many of the towers existed as municipal activities before the authorization was passed.

UAL Employment Plan

United Air Lines has a continuing program to get back its 1300 employees who have gone to war and to re-train them, when required, in the new procedures of flying, operations, communications, maintenance, etc. Russ F. Ahrens, United's personnel director is in charge. United personnel has expanded from 4,300 in 1941 to nearly 8,000 in 1944. Company estimates that figure will climb to 18,000 within four years after the war. Ahrens is keeping in contact with his 1,300 service men and women by mail, finding out their aspirations by questionnaire.

Re Transport Weight Rises

Pilots from all of the airlines testified in recent CAB hearings, against promulgation of the CAB authorization, first proposed about a year ago, to increase takeoff weight of the Douglas DC-3 by 1,000 lb. and landing weight by 800 lb., also to "up" both landing and takeoff weights of the Lockheed *Lodestar* by 1,000 lb. Increases would apply only to ships fitted with Wright G-202 or P. & W. S1C3G engines and then only under proper flight conditions. Pilots related unhappy experiences and said the DC-3 is a '36 model no matter what power is added, CAB engineers meanwhile quoted figures supported the poundage rises. Outcome of the controversy is as yet unpredictable.

SURPRISE FOR PRESIDENT PATTERSON

Completing 10 years as president of United Air Lines and 15 yr. service with company W. A. Patterson received a surprise award from a representative employees' committee—a silver plaque lauding his leadership and signed by 667 employees who worked under him through the decade. Presenting plaque to Pres. Patterson is O. E. Kline, lead mechanic at Chicago while looking on are (left to right): R. Edwards, Chicago station manager, N. Fry, acting general traffic manager; A. Akins, Mr. Patterson's secretary; H. Knoop, superintendent eastern flight operations; L. Davis, auditor of general accounts; and E. McMahon, Chicago passenger service.

Traffic in Broad Gains

ATAA reports sharp gains in first quarter operations of domestic airlines. In this period revenue passenger miles were estimated to exceed 485½ million, a 40 percent "up" over the first quarter of '43. Other figures were 22½ billion mail pound-miles (against the old 15 billion); 36 million mail pounds carried (against 23¼); 8¼ billion express pound-miles (against 6½); and 13¼ million express pounds carried (against about 13).

United Seeks Hawaii Run

Applications have been filed by United Air Lines for franchises that would add 16 new stops to its coast-to-coast and Pacific Coast airways network, also for a new line between the Pacific Coast and Hawaii,

W. A. Patterson, United president, has announced.

The 18 new stops, which would add 20 western cities to those now serviced, are: Ogden, Utah; Twin Falls, Ida.; Baker, Ore.; The Dalles, Ore.; Lewiston, Ida.; Clarkston, Wash.; Yakima, Wash.; Aberdeen-Hoquiam, Wash.; Olympia, Wash.; Centralia-Chehalis, Wash.; Astoria, Ore.; Marshfield-North Bend, Ore.; Bend, Ore.; Chico, Calif.; Eureka, Calif.; Santa Rosa, Calif.; and San Luis Obispo, Calif.

On the proposed Hawaii route United plans to use four-engined, 52 passenger planes, presumably DC-4s.

S. V. Hall, company regional vice-pres. at Denver, has been appointed manager of United military operations for the Air Transport Command in Alaska and the Pacific.

Launch New WAL Service

Service was inaugurated between Los Angeles and San Francisco, by Western Air Lines, on May 1. Three daily round trip schedules will take off alternately from Mills Field, San Francisco, and Lockheed Air Terminal, Los Angeles, all operating on a two-hour non-stop basis. Douglas DC-3 planes are being used in this service.

Roy Backman has been appointed district traffic manager of the Line's new San Francisco office, temporarily located in the St. Francis, but soon to be established at 287 Geary St. He is assisted by Clay Bernard, Tempest Williams, and Margaret Robinson. Operations offices at Mills Field are under the supervision of Joseph L. O'Neill.

FOR PRIVATE FLYERS ONLY

Here's a personal plane airport for congested areas proposed for St. Louis by Oliver Parks, of Parks Air College and member of city's Aviation Commission. Such a downtown port would have 1,600-2,000-ft. landing strips with total width of a city block. Underpass (see detail) would connect strips and but two streets would have to be closed for each strip. Parks also has plans for outlying skyports.

Route Applications

Airline route developments: Oklahoma Airlines new organization, will apply for a system of lines around Oklahoma City. . . . Engel Aircraft Specialties has filed for three feeder routes out of San Diego. . . . Pueblo Air Service, until recently a training school, asks for routes in southeastern Colorado. . . . Fourteen fixed base operators forming Consolidated Airlines have asked for 64 routes in central states. . . . Alaska Airways and Woodley Airways file for mail service between Anchorage and Kodiak. . . . Ryan School of Aeronautics files for trans-Pacific service from California to Calcutta, India, with a branch at Canton, China, 13,760 mi. in all, also for another route between Los Angeles-San Diego and Havana, Cuba. . . . Seas Shipping Co. asks for certificate to parallel by air their ship line between New York and South Africa. . . . Aero-Transportes, S. A., Mexico City, asks for permission to operate from Piedras Negras, Mexico to San Antonia via Eagle Pass, Tex. . . . And Fish Airlines Corp., New Bedford, Mass., wants to transport seafoods to points in Eastern states.

Re Swivel Wheel Gear

Light plane builders and pilots were reported increasingly interested in swivel wheels for cross-wind landing. Experiments recently made in England are being followed up in this country. The idea is not new; it was tried out long ago. Recent tests by a light plane builder showed that crosswind landings are easily made with wheels independently swiveled, swiveled and connected by a tie-rod, or held semi-rigid by springs. If swivel wheels should prove practical on planes of all sizes it would make a vast difference in the cost of airports, many of which could get along with single or parallel runways.

About 73-Octane Rationing

OPA was getting ready, at this writing, to tighten rationing of 73-octane aviation gas used mostly by personal and by fixed base services. Gasoline is rationed to these classes by local boards, and there have been a few chiselers. Now CAA has offered to certify plane owners entitled to gas rations, also to tabulate the amount of fuel required for various power ratings. There is actually more gasoline for flying than ever since WTS and contract training are being stopped.

★ CROSS COUNTRY ★

Two American Export Airlines pilots lowered the commercial record for non-stop Trans-Atlantic flights. Capt. Edward A. Stewart left New York Apr. 13 and arrived in Ireland Apr. 14—time 15 hr. 51 min. Capt. Charles A. Thompson left New York Apr. 19 and arrived in Ireland Apr. 20—time 15 hr. 30 min. Planes were the VS-44A Sikorskys.

Continental Air Lines has been authorized by the CAB to extend its present routes to include operations between Hobbs, N. M., and San Antonio, Texas.

Special mechanical equipment for spreading cement in well-cement surfacing has been developed by CAA and Halliburton Oil Well Cementing Co., and all equipment can be transported by air.

United Air Lines ton-miles flown increased 49 percent in March over same month in 1943. It was recently reported.

Operators of small airports in New England have organized as a permanent group to promote development of aviation and help with problems at any and all New England airports.

Atlantic Coast Express, Richmond, Va., has been granted a charter by Virginia State Corporation Commission to do air and motor transportation business.

American Airline figures were up for first quarter, with revenue passenger miles increasing 10.6 percent to 102,117,357. Total revenue miles flown increased 5.3 percent. Pound miles flown in the three months were 4,770,919,722, an increase of 46.2 percent, and express pound miles increased 11.2 percent.

CAA has published following pamphlets: "Aircraft Corrosion Resulting from the Use of Calcium Chloride on Airport Runways," by C. J. Janes of Technical Development Div., and "The Establishment of a Restricted Area for Seaplane Operations," by F. H. Grieme, Technical Development Division.

Braniff Airways has been granted an amended certificate to serve Topeka, Kan.

Pan American World Airways System has inaugurated daily round trip passenger flights between Rio de Janeiro and Sao Paulo.

Formation of the New York Air Commerce Committee is announced by Chairman John F. Budd, of the Aviation Section, New York Board of Trade. Purpose is study of the roles of various industrial officers should play in the coming air commerce.

For use of its Latin American Clipper clientele, Pan American World Airways System has printed two vest pocket "flying language dictionaries," one printed in Spanish and English, the other in Portuguese and English.

An "international travel packet" is being issued by Continental Air Lines to its Mexico City passengers. The packet contains pockets for tickets, baggage checks, passports, etc., also includes a small pad for notes and a check list.

Airport Section of CAA's Technical Development Div. has developed a special searchlight at request of Airline Pilots Association. Designed for use in conditions of low visibility and where smoke conditions prevail, light beam pivots from a vertical position down to a near horizontal position where it indicates the direction to the airport. In smoke and haze light is visible at about 1,000 ft. CAA pilot tests have proven it effective and airline pilots will test it soon.

Application for a new route between Washington, D. C., and Montreal, Can., has been filed by Pennsylvania-Central Airlines.

Lexington Flying Service, Inc. applied to the Kentucky Aeronautics Commission for permission to operate planes strictly intrastate between Lexington and two other Inter cities in the state and it has already bought two five place planes.

Compania Mexicana de "Aviacion," Mexican affiliate of PAA, announces additions to its service between Mexico and the U. S. and Mexico and Cuba.

U.S.-Britain Now Agree on Basic Postwar Air Principles; International Body Planned

British plants building postwar craft; Americans irked . . . Minor Lines meet to form air traffic group.

Britain, it is announced, has "reluctantly" agreed to certain basic precepts set up by the United States for postwar commercial aviation. The plan, to be known as the "four freedoms of the air," would give any certified United Nations airline the right to fly, land, discharge or pickup passengers at any airport in the world. This plan is in decided contrast to a previous Canadian plan which would have rigidly fixed services, schedules, and number of passengers.

The American plan involves the establishment of an international body to regulate air traffic as to safety, economic aspects, and other factors, at the same time eliminating cut-throat competition.

While the British gave in to the United States on the freedom of the air plan, the demands in some official American quarters that this country acquire permanently the bases which have been built for the ATC were flatly turned down by Lord Beaverbrook. These bases would be controlled by the proposed international authority, he said, and would therefore be available to the airlines of the world.

At the same time, Lord Beaverbrook suggested that present or proposed lines may offer concrete plans to the Government if they objected to the BOAC "chosen instrument" policy.

Swing of British policy to the American viewpoint represents a major victory for Berle and Warner. Even if only the British Empire and the United States agree 'round-the-world airlines can easily be established networking British and American possessions.

British Plants "Previous" On Postwar Craft

Certain British manufacturers seem to be starting active production of commercial transports, even selling them to airlines, and accordingly something of a roar has arisen in the United States.

In April, this department told of initial construction on the "Tudor", moreover other British plane conversions were reported. Apparently these programs have progressed further than was originally known, judging by the announcement from England that KLM has placed a substantial order for "Tudors".

This news does not seem to "gee" with a recent statement by Lord Beaverbrook that since American aircraft producers were concentrated on large bombers, they could more easily convert to passenger plane production, and that with British plants concentrated more on fighter production, America would have to lend-lease or sell commercial aircraft to Britain and other countries until such a time as British plants could develop and place into production their own commercial planes.

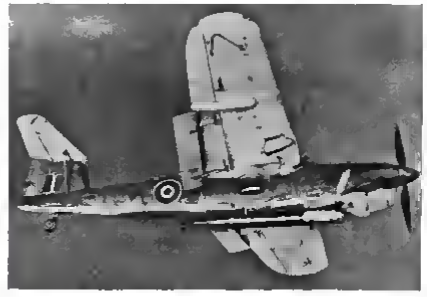
There seems to be some conflict between facts and official pronouncement, and U. S. manufacturers, who in the past sold a considerable part of their output outside the United States feel that if the British are allowed to develop and build postwar planes they, too, should be allowed to divert at least part of their facilities to the building of aircraft which would open international markets for them.

Minor Lines Meet to Form Air Traffic Group

Airline operators from eight countries recently met to form a new international airline association, to be known as the Conference of International Air Traffic Operators.

Caller of the conference was the small independent British North Eastern Airlines, which identified the meeting's main purpose as a discussion of the postwar problems which would face the smaller countries particularly the obtaining of necessary air equipment.

Some circles look upon this get-together as an attempt to force the hand of the 'Big Three" on postwar commercial aviation plans but at this time no definite information seems to be available.



TORPEDO-TOTING 'BARRACUDA'

Latest British torpedo bomber is this Fairey 'Barracuda," which damaged the Tirpitz" in its fjord hideout. Powered with a 'Merlin," top speed is 254 mph at 12,000 ft. Novel features are wing-root hatchwindows for navigator; very high stabilizer; and unique flaps. Latter can be placed at various angles to serve as auxiliary lift devices in takeoff as diving brakes, and also as landing flaps. The "Barracuda" is for use on carriers. Its wings fold back toward tail like those on Grumman "Avenger." Landing gear of the new plane is of very narrow tread, and for this reason auxiliary wingskids (see photo) have been installed. Note undercwing vanes between aileron and flap: these are undoubtedly used to add lateral stability by smoothing out airflow over rear part of wing and flap. (Acme photo)

ON SCNEDULE . . . . By "VISTA"

News that KLM Royal Dutch Airlines had placed an order for early delivery of a substantial number of Britains' forthcoming "Tudor" transports came as a surprise to many persons in American aviation.

Background and development of this line makes this choice of new equipment curious, since KLM had been using U. S. airplanes exclusively since 1935, building up excellent Europe and Far East airline networks with them. A further question arises: Will KLM now cancel its rather substantial order (booked in 39) for large Lockheed transports of an advanced type?

Experience has certainly shown that two different type craft in one operation do not mix. As a solution KLM would have to concentrate on the use of one type, and in view of the size of the 'Tudor" order, the company apparently has decided to base all on the Tudor, an as yet unknown and unproved airplane. And so the question: Is a trend away from American equipment to be expected?

Well informed quarters trace the company's action to the new management installed by the exiled Government, certain members of which have for a very long time fought every purchase of American equipment with the claim that Netherlands' own industry (Fokker) could build better and cheaper aircraft. In 1939, sanction for the purchase of Lockheeds was only obtained after the KLM agreed to call upon Fokker for a new type plane to be known as the F-24. The latter craft cannot be obtained, but the pressure apparently is still sufficient to force purchase of English transports.

★INTERNATIONAL BRIEFS★

Polish interests have opened an aero department in London, possibly aiming for postwar re-establishment of the LOT lines.

RAF Fighter Command has been dissolved in favor of establishment of two new groups: the Tactical Air Force and the ADGB (Air Defense of Great Britain).

Arrivals and departures at Foynes, Ireland, are reported averaging around 695 per month.

Bristol has set up a permanent Aviation Corner' on Piccadilly in London—a showroom available to anyone connected with British aerial interests.

Misr Airlines, largest company in Egypt, has plans for an airline to England as its initial international venture.

Boeing Airplane Co. reports net sales of $493 183,186 in 1943 against $389,567 319 in 1942, while net income dropped to $4,492 870 or $4 14 a share from $5 237 924 or $4 84 a share in 1942 despite the large increase in volume last year. A postwar refund of $2 545,000 in 1943 and one of $2 860 000 in 1942 were both transferred to a reserve for development of postwar products and markets.

Transcontinental & Western Air has purchased a 20 percent interest in Hawaiian Airlines, Ltd. from Inter-Island Steam Navigation Co at a cost of $300,000. The Hawaiian concern has a fleet of six planes engaged in passenger, mail, and cargo service in the islands. The steamship company expects to divest itself of control of the island airline as soon as the latter is permitted to extend its service to the Pacific Coast. Hawaiian Airlines had a gross of $1 613,973 and net of $132 054 last year.

Lockheed Aircraft Corp. reports sales of $897 408 187 last year against sales of $481,180,471 in 1942. Net profits were $7 988,420 or $7 42 a share in 1943 compared with $6 163 721 or $7 59 a share the previous year. Reserves for postwar adjustments at the end of 1943 totaled $18 052,000 against $12 891 000 in 1942. Notes payable were listed at $90 000,000 on the 1943 balance sheet.

Luscombe Airplane Corp. reports net profit of $159 153 or 46c a share in 1943. Gross sales, after voluntary price reductions of $119,000, were $3,229 250 against $1 029 300 in 1942. The balance sheet revealed current assets of $1 205,872 including cash of $174 237 against current liabilities of $789 712. Notes peyable were $200,000.

Liberty Aircraft Products has acquired 56,488 shares of its common stock from Grumman Aircraft Engineering Corp. Liberty does not intend to reoffer this stock which Grumman bought from it in 1940.

Jacobs Aircraft Engine Co. reports sales of $63,915 622 in 1943, after a voluntary refund of $5,000 000 to the Army Air Forces against sales of $34,437,494 in 1942 following a $4 500 000 tentative renegotiation settlement. Earnings were $1,890 563 or $3 05 a share against $1,708,478 or $2 79 a share in 1942. Earnings last year are subject to renegotiation, and there is a renegotiation claim of $500,000 outstanding on 1942 profits in addition to the tentative settlement by the regional board as mentioned above.

New Air Companies: Dunkirk Aeronautical Corp. has been incorporated at Buffalo, N. Y., with a capital of 200 shares. Marvin Morrison, Louis Morrison and Helen Hapke are the incorporators. . . . Carl Dolan Corp., newly formed firm in New York City, has purchased machinery and equipment of Essential Industries Corp. . . . Oklahoma Airlines has been formed to seek CAB approval to serve a trade area of smaller communities around Oklahoma City. T. E. Braniff, president of Braniff Airways, is reported to have put in $25 000 of the $100 000 in capital already subscribed.

ADDING IT UP . . . . By RAY HOADLEY

The real "war babies." Stock market prices bear more relation to postwar prosperity than to wartime earnings, according to a Commerce Department study of the stock market. In the case of the aircraft stocks, the market has been on a downward trend since 1940, in the first quarter of 1944 being about 30 percent below that of 1939. On the other hand prices of the automotive group, rubber concerns, and many others, are higher than in 1939. No wonder the aircraft stocks are no longer called "war babies."

Postwar taxes. In another interesting study made by the Harvard Business School, the rapid growth of Lockheed Aircraft Co. in the 1930's is analyzed to show that high postwar corporate income taxes would seriously curtail the expansion of small business concerns. It was found that Lockheed's remarkable prewar expansion would have been virtually impossible in the face of corporate tax rates likely to prevail in the postwar decade. If Lockheed had had high tax rates during its early expansion, the report shows that benkruptcy would have been almost inevitable.

Lockheed's case. Development of the *Electra* transport was undertaken by Lockheed in 1933 with assets of less than $200 000 and net working capital of about $75 000. Output of other models had to stop, and large amounts of outside capital had to be secured from stockholders and customer advances. At the end of 1934 Lockheed had only $72 000 in current assets other than inventory with which to meet $289 000 of current liabilities. If the *Electra* development had failed, bankruptcy would have been certain. But if a large firm making other products had undertaken such a project, any losses would be deductible from income earned from other activities. Thus the long-established firm would not be seriously deterred from developing new products by a high tax rate.

Surplus disposal. Beech Aircraft Co. is well on the way toward solving its surplus disposal problems through formation of a separate Beech-owned company to take over excess materials. In its first three months of operation, the new company moved about $300 000 worth of materials a month. Inventories can be transferred from the parent concern, a fact that should both simplify and speed contract termination procedure.

Across the border. Canadian aircraft manufacturers are in about the same boat on war business as their American neighbors, judging from the 1943 report of Noorduyn Aviation. Pointing out that Noorduyn, with small original capital and large turnover is in a vulnerable position, the report stated that the present Canadian tax policy (100 percent on excess profits) neither allows incentive nor permits the company to insure its immediate postwar position.

Termination financing. Barney Baruch, who laid down the blueprints months ago for Congress to follow in termination legislation, is known to fear that the lawmakers may not get around to passing a suitable bill before the elections. If Germany should suddenly quit, as she did in 1918, that would mean that no means would be readily available to finance the termination loans that industry will have to have when the cancellation telegrams are rushed out from Washington. Main reason for the delay in Congress Baruch tells his friends, is the development of many side issues in the termination bills—issues that are all good for weeks of argument on the floor, such as wage dismissal provisions and supervision of terminations by the general accounting office.

United Aircraft shipments in the quarter ended Mar. 31, 1944 were $215,280 014 while net profit, subject to renegotiation, was $4,080 828 or $1 40 a common share. Postwar adjustment reserves of $2 170 000 were deducted from earnings.

Aircraft Accessories Corp. reports net profit for the nine months ended Jan. 31, in excess of $715 000 or $1 a share. Sales were more than $28,000,000 and volume now is running close to $4,000,000 a month.

Fairchild Orders. Backlog of Fairchild Engine & Airplane Co. was around $165,000 000 on Mar. 31 compared with $140,000,000 at the end of 1942. Fairchild Camera & Instrument Corp. reports unfilled orders "sufficient to keep plants busy for some months to come." Sales of Fairchild Engine in 1943 were more than double those for 1942 according to Pres. J. Carlton Ward, Jr., while Pres. James S. Ogsbury of Fairchild Camera report 1943 sales of $52,056,000 against $17,727,000 in 1942. Annual reports of both companies have been held up by renegotiation proceedings.

Warner Aircraft Corp. reports net profits for 1943 of $169 989 or 34c. a share compared with net profits of $87 288 or 17c a share for 1942. Last year's earnings are subject to renegotiation while the 1942 figures are after renegotiation.

Thompson Products reports sales of $35,789,983 for the quarter ended Mar. 31 against $30,112,251 in the like 1943 period. Thompson Aircraft Products Co. accounted for $14,410,858 of the 1944 gross and $11 591,291 of sales in the like 1943 quarter. Net earnings were $795,006 or $2 47 a share against $719,088 or $2 31 a share in the same quarter of 1943. Voluntary price reductions of $30 000 000 have been made on shipments already completed, according to Pres. F. C. Crawford.

National Aviation Corp. reports an indicated net asset value of $19 42 a share on Mar. 31, while net income for the three months ended Mar. 31 was $23,913.

Aviation People

CAPT. AUBREY D. DURST, who has flown for Pan American since 1930 was named chief pilot of the Atlantic Division to fill the vacancy created by the appointment of Capt. Harold E. Gray as division manager of operations. (Pan American photo.)

JOSEPH M. CARR, assistant general manager of the Chance Vought Aircraft division of United Aircraft Corp., has been named manager of the export department of the corporation and has relinquished his former duties at Chance Vought.

GORDON G. JOHNSON is appointed plant manager of the Lycoming division of The Aviation Corp. He has been acting plant manager and previously, controller of The Aviation Corp. He also served for a period as assistant treasurer of Lycoming.

DR. STEPHEN J. ZAND, director of the Vose Memorial high altitude laboratory at the Sperry Gyroscope Co. at Great Neck, L. I., N. Y., has been elected a Fellow of the Royal Aeronautical Society, the 13th American to be so honored. (Sperry photo.)

COL. JOSEPH BENJAMIN PATE, recently retired from active duty in the Regular U. S. Army, terminating 42 yr. of military service, has been appointed special representative for TACA Airways System and will be stationed in Washington, D. C.

HOWARD L. HARTMAN has become executive assistant of the Chance Vought Aircraft division of United Aircraft. In his new connection with United he rejoins the organization which he served for 11 yr. in the Pratt & Whitney division. (Piver photo.)

EUGENE W. WASIELEWSKI was appointed chief engineer for McCulloch Engineering Corp. Formerly with the NACA working on design of superchargers, he has aided in supercharger development work with Fairchild Engine subsidiary companies and Strates Corp.

T. C. SULLIVAN is appointed assistant to the president of United Aircraft Corp. He was formerly with the Wall Street News then joined the Wall Street Journal in 1935. In 1940 joined Vultee Aircraft, Inc., as asst. to the president and secy. of the corporation.

E. B. SPORLEDER, executive engineer of Douglas Aircraft Co., was named national chairman of the Airworthiness Requirements Committee of the Aeronautical Chamber of Commerce of America at the recent first annual meeting of the Committee.

EVAN E. YOUNG, who has been v.p. in administrative charge of Pan American Airways' air transport routes in Latin America, has retired from active duty. Before joining PAA, he served as minister to the Dominican Republic and Republic of Bolivia.

ARMAND J. GARIEPY, appointed contracts and service manager for Lawrance Aeronautical, will direct the service department, also contracts, advertising, and public relations. He was formerly with RDC Aviation Division.

DR. DONALD HILLS DAVENPORT, former college professor and government economist, has taken up the duties of Director of Business Research for the Curtiss-Wright Corp., Airplane division, with headquarters at Buffalo, N. Y.

WILLIAM B. BIRREN has been named sales and service manager of Wright Aeronautical Corp. He has spent more than 27 yr. in the aviation industry both in field service and engineering work, and before taking over his new duties he was service manager of Wright Aeronautical (since 1940). Simultaneously with his appointment, JOHN T. WETZEL was named service manager. His association with Wright began in 1931, and he has been in the service department since that time.

KARL P. GRUBE has been appointed manager of Douglas Aircraft Co.'s newly created corporate termination claim committee, established to formulate and administer company policies and procedures essential to contract matters.

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Products and Practices

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ENGINEERING DATA

Combustion Data 1

Houck Industrial Combustion Data. 112 pages of data on industrial combustion and heating practice in a reference book for those concerned with selection, installation, operation, and maintenance of combustion equipment oil or gas, on furnaces, ovens, kilns, retorts, air. Issued by Houck Mfg. Co. Brooklyn, N. Y.

Radius Charts, Etc. 2

Bulletin 1 [illegible], from Universal Eng. & Colorplate Co., Buffalo, covers complete line, including several new items of radius charts, protractor charts, scales, and rules for use on all makes of optical comparators, measuring and micro projectors. Comparison booklet, Specifications and Prices lists models of projectors or comparators on separate page in comparison with sizes of recommended charts.

Aircraft Heaters 3

"Whirl flame" operating principle of new surface combustion type Janitrol high altitude aircraft heater is described and illustrated in new bulletin issued by Surface Combustion Co., Toledo. Unit is designed to meet all requirements of modern high altitude aviation.

Porous Metal Filtering 4

As filtering element in aircraft engines, "Porex," produced by powder metallurgy by Metalex Products Div., General Motors, Dayton, Ohio, is described in booklet. Given are examples of shapes commonly used, fields of application, information on design and engineering data, laminating thickness table, particle stoppage table, limitations on size and shape, physical properties, directions for use of flow curves, and viscosity conversion chart.

Synthetic Resins 5

Bulletin No. 6 from Resinous Products & Chemical Co., Philadelphia, contains technical data for users of plywood to aircraft. It is stated that use of the new synthetic resins makes possible a utilization of higher percentage of old veneers delivered by manufacturer and solves problem of repairing split sheets.

Buyers Encyclopedia 5

A buyers' encyclopedia featuring more than 500 items for industrial maintenance, safety and fire protection fields is offered by General Detroit Corp., Detroit. Given is factual data on sizes and types of hose threads, nozzle and fire stream data and proper maintenance of fire hose.

Retainer Rings 7

Engineering Folder No. 43 released by Kaiser Mfg. Co., Airliner Div., Massillon, Ohio, covers engineering data on retaining rings for SAE standard bearings, housing and shaft applications. Contains general information and ready reference on dimension and parts, and steel sections, for engineering designing and purchasing.

Plywood 8

Arlina Plywood & Veneer Co., Chicago, announces *Victory Book*, in color and profusely illustrated. Offered is information on "Plywood in and After Victory," and copyrighted feature "Triply Tikrit"—fair data about availability of plywood and veneer.

PRODUCTION

Packing War Material 9

Speed Packing Manual for War Material issued by Sherman Paper Products, Newton Upper Falls, Mass., contains section on protection against corrosion and discusses materials issued by various branches of armed services to give shipping man a brief accurate explanation of methods. References to original specifications are included.

Screw Thread Inserts 10

Heli Coil screw thread inserts used as antifriction thread lining or bushing for tapped threads of American National Screw Thread System, together with necessary tools, are described in bulletins issued by Aircraft Screw Products Co., Long Island City, N. Y. Also given are specifications and design and installation data.

Hot Coiling of Springs 11

Folder published by Muehlhausen Spring Corp., Logansport, Ind., illustrates and describes methods used in hot rolling large springs. Shown in sequence are various steps in manufacturing facilities necessary also operations required.

Metal Bellows 12

Principles, construction, and engineering advantages of "Spring-life" bellows are portrayed in new catalog issued by Cook Electric Co., Chicago. Photographs and diagrams aid explanations of characteristics and construction and included are application chart and suggestions for selection of proper bellows for specific requirements.

Aluminum Alloy Extrusions 13

Conservation Bulletin No. 84, aircraft Production Board, discusses extrusion situation and allocation in relation to NASC catalog of aluminum alloy extrusion dies and catalog of rolled form sections.

Soluble Cutting Oils 14

Soluble Cutting Oil at Its Best discusses problems involved in selection and application of water-mix oils. Illustrated with photos of machining operations and laboratory tests. D. A. Stuart Oil Co., Chicago.

Conduit and Conduit Fittings 15

Bulletin A 60 from American Brass Co., Waterbury, Conn., replaces *Bulletin A 16* illustrating and describing American flexible shielded conduit, shielded conduit fittings, and other aircraft products.

Waxes 15

Waxes for Today and Tomorrow, from Distributing and Trading Co., New York, technically discusses various waxes, substitutes, and extenders. Tried are 36 blends with specifications.

Lubrication Program 17

Sun Oil Co., Philadelphia, announces *Save and Serve Campaign*, a program to help industry save time, machines and labor. Comprises booklets, wall charts, posters, folders, technical bulletins, and miscellaneous memos.

Hard Rubber 18

Distinctive qualities of hard rubber are listed in new catalog from B. F. Goodrich Co., Akron. Applications of various types are listed, also kinds of products which can be successfully made from material. Suggestions for working are given.

Blind Riveting Manual 19

Cherry Rivet Co., Los Angeles, has published new manual on use of Cherry rivets, illustrated in color sketches. Manual covers description of blind rivet, drilling of hole, setting of rivet, pulling head, installation procedure, etc.

Fasteners 20

Fasteners in title of booklet issued by American Institute of Bolt, Nut & Rivet Manufacturers. Explained is inauguration of a program of technical research. Contains several articles, illustrations and factual material.

AVIATION READER'S SERVICE — JUNE 1944

AVIATION, 330 W. 42nd St., New York City

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NEW PRODUCTS																		
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	86	87	88	89	90													

NAME TITLE

FIRM OR AFFILIATION

ADDRESS

Graphite Parts 21

United States Graphite Co., Saginaw, Mich., has published a booklet on product "Graphitar" describing its characteristics and application, such as in rotary pump blades, turbine packing rings, rotary pressure joint seals, clutch release bearings, pump seals, piston rings and metering disks.

MACHINERY & ACCESSORIES

Hydraulic Test Machines 22

Machines for testing aircraft hydraulic systems, for inspection and operational testing of single or complete line of hydraulic components, or for research and development testing are described in bulletin from Greer Hydraulics, New York.

Locating Spotlight 23

Bulletin from Sylvania Bros., Chicago, illustrates and describes a locating spotlight for use on white range of production machinery.

Broach Pull-and-Push Heads 24

Broach Head Circular, from American Broach & Machine Co., Ann Arbor, Mich., covers all types of broach pull-and-push heads.

Tensile Tester 25

Bulletin from W. C. Dillon & Co., Chicago, describes company's tensile testers, their construction features, and applications to precision testing.

Spot Welders 26

Manual and automatic spot welders made by Pier Equipment Co., Benton Harbor, Mich., are shown in recent catalog. Details of important parts, regulator controls, automatic weld timer are given. Welding capacity charts for all welder sizes and different throat depths are included.

Rotary Shears 27

New illustrated bulletin on Kling rotary shears made in six sizes, is offered by Kling Bros. Engineering Works, Chicago.

Electric Test Instruments 28

Catalog describing multitesters, vacuum tube testers, insulation testers, electronic voltmeters. Built bridges for precision resistance testing, combination tube, battery and set testers with plug-in adapter units to meet requirements of aircraft production testing laboratory and shop purposes, is offered by Radio City Products, New York.

Truck-Tractors 29

Illustrated and with specification data, new vest pocket catalog of factory trucks and tractors has been issued by Clark Equipment Co., Battle Creek, Mich.

Air Compressors 30

Catalog illustrating and describing Sullivan air compressors, accessories and installations is offered by Sullivan Machinery Co., Michigan City, Ind.

Current Regulator for Welders 31

How to control current variations in welding is subject of bulletin from General Electric Co., Schenectady. Application description and operation of current regulating compensator is given.

Welding Equipment 32

Booklet from Victor Equipment Co., San Francisco, is descriptive of company's products and their applications, published for the enlightenment of users, employees, and stockholders.

Gages 33

Hanes Gage Co., Philadelphia, has published a bulletin featuring a wide variety of made-to-specification precision gages—plug, ring, snap, flush pin, and profile.

Infra-Red Case Histories 34

Brochure from Fostoria Pressed Steel Corp., Fostoria, Ohio, offers case histories of drying and heating problems with infra-red equipment, referring particularly to small installations.

Gear Pullers 35

Gear pullers, among other gear tools, are now coming into stock, according to announcement from New Britain Machine Co., New Britain, Conn.

Hole Punching Units 36

Catalog describes Wales hole punching units which punch series of holes simultaneously in extruded and shaped sections. Maker is Wales Strippit Corp., North Tonawanda, N. Y.

Dust Control 37

Catalog of dust collectors, with complete engineering information, applications, list of users, etc., is offered by Pangborn Corp., Hagerstown, Md. Company also is issuing condensed catalog of equipment for various types of blast cleaning equipment.

Carbide Tool Blanks 38

Carbide Tool Co., Detroit, announces line of standard Carboloy tungsten carbide tool blanks from stock in bulletin just issued. Total of some 640 types are available.

ELECTRICAL

Electric Instrument Parts 39

New parts publication, prepared by General Electric Co., Schenectady, covers 2½-in. d'arsonval and rf ammeters and voltmeters of new intermittent design for aircraft. Illustrated arrangement exploded in proper relation to each other.

Insulation Tester 40

Bulletin No. 416 from Herman H. Sticht Co., New York, describes new model C-2 Megohmit (insulation tester). Unit is claimed to be a radically new development, inasmuch as new spillproof lightweight storage battery is used as power supply.

Snap Action Relay 41

Engineering data bulletin describing redesigned THAX snap action relay and giving circuit application diagrams is offered by Struthers-Dunn, Philadelphia.

METALS & PLASTICS

Zinc Alloy Die Castings 42

New technical department bulletin *Zamac Alloys for Zinc Alloy Die Castings* is published by New Jersey Zinc Co., New York. Described are composition limits, mechanical properties, test methods, corrosion resistance, methods of finishing, machining, assembling of castings, and other technical data.

Plastic Tubing 43

New illustrated catalog from Irving Varnish and Insulator Co., Irvington, N. J., describes company's fabricated extruded plastic tubing, its characteristics, and applications.

Resin Plasticizer 44

New bulletin describes Paraplex G-25 developed by Resinous Products & Chemical Co., Philadelphia. This plasticizer is reported resistant to oils, gasoline, and heat, also as showing promise in polyvinyl chloride cable compounds and cable lacquers, wire enamels, vinyl resin fabric coatings, isobutyl compositions, aircraft gasket and caulking and sealing compounds. Product is a saturated polyester thermo-plastic and thermosetting since it can be used for all polyvinyl chloride resins and elastomers of the acrylonitrile butadiene type stated maker.

Polyvinyl Resins 45

Folder issued by the chemical division of B. F. Goodrich Co., Akron, describes group of resins and plastics recently developed under trade name Geon. Two resins are special polymers of vinyl chloride stated to be marked for their thermal and light stability, toughness, and general inertness. Others are vinyl chloride—vinylidene chloride copolymers which combine solubility and thermoplasticity with stability, chemical resistance, and wide useful temperature range. Geon plastics are also described, and given in a partial list of applications.

Thermostatic Bi-Metals 46

Callite Tungsten Corp., Union City, N. J., has issued new technical bulletin on thermostatic bi-metals. "Calilloy" bi-metal is used as a temperature responsive element in automatic control and is available in five types according to requirements given in data on deflection power of various types in strip and coil, and sizes.

Steel Mold for Plastics 47

Shaping Tomorrow Today describes methods of design and manufacture of steel molds for plastics and die cast metals used by Midland Die & Engraving Co., Chicago. Polished mold is important of mold in quality of finished product.

MANAGMENT & EMPLOYERS

On Scheduling Shipments 48

Materials and Scheduling Office of War Production Board has issued *Scheduling Primer*, which describes proper procedure in scheduling shipments from plant.

New Products Check Chart 49

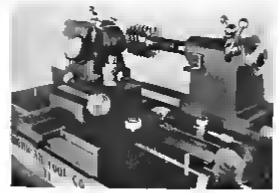
New *Products Check Chart*, developed by Designers For Industry, Cleveland, for use of manufacturers engaged in postwar planning, provides means of appraising new products being considered for manufacture.

NEW PRODUCTS

Latest Machine Tools

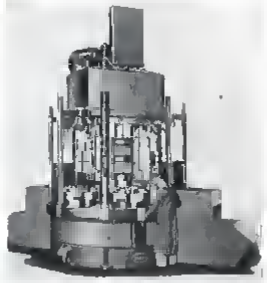
Hob and Milling Cutter Checker

To completely check correct re-sharpening of hobs and milling cutters, a new machine has been developed by Michigan Tool Co., Detroit. Hobs or cutters with max. o.d. of 10 in. and max. length of 8 in., arbor or shaft length max. 18 in., may be checked for sparing of flutes—either parallel or spiral gash—rake angle of flutes, parallelism of straight flutes, taper on o.d. and concentricity of profile dia. by means of two standard interchangeable indicator assemblies. Two additional assemblies are available for checking lead of hob or spacing of threads in multiple thread hobs, measured in a plane parallel to axis, also for checking depth of tooth at tapping hob. To simplify setting of indicators for checking rake angle, parallelism, etc., a ground surface block, top edge of which is in same horizontal plane as headstock and tailstock centers, and projecting ledge in a parallel plane, is mounted on tailstock and used for initial settings. Projecting ledge is used with "Jo" blocks to set indicator for checking hooked or raked hobs. Initial settings are accomplished by rolling indicator opposite ground surface block and adjusting vertical setting of indicator. "Jo" blocks may be placed so that any desired setting may be obtained on, above or below center. After initial setting, indicator base is reversed opposite tool for checking sharpening inaccuracies. In or out movement of indicator base is provided by hand operated gearing, a knurled locking screw holding this at any desired position. Cut shows checker checking rake angle and parallelism of hob after sharpening.—AVIATION, June '44.



"Multi" Processer 51

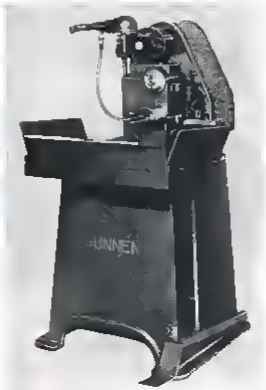
A new and larger "Mult-Au-Matic" designed for operations on component parts of airplane engines, transmissions, etc., is announced by The Bullard Co., Bridgeport, Conn. It machines work up to 34-in. dia. and to 2⅜ in. height. Six heads—two at each working station each with independent feed works, each providing vertical, horizontal or angular motion—are designed to make possible work of six working stations, with three



stations. All heads are counterweighted hydraulically with an adjustment to give more or less weighting. A specially designed indexing and locking mechanism is to permit smooth indexing and provide rigid positioning and locking of carrier at completion of index. Unit has push button controls, and forward or backward motions are obtainable. An adjustable column carrying tool heads permits moving up and down of all six heads as a unit. Dual speed range gives low speed with more power for heavy cuts, or high speed for smaller diameters. One or two spindles may be in low speed while others are in high range. A fluid motor drive at loading station jogs spindle for targetting and indicating.—AVIATION, June '44

Nosing Machine 52

Reporting it to be simple and economical Sunnen Products Co., St. Louis, announces precision honing machine for sizing and finishing holes in virtually any



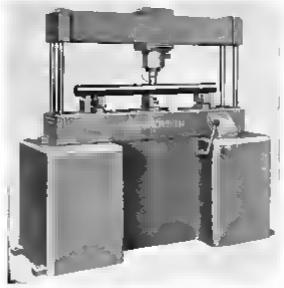
metal, also in plastic and ceramic parts. It is said that unskilled workers can produce excellent results on this machine, which can be set up in about one minute for any size from 1/8 in. to 2.625-in. dia. For sizing and finishing on this machine Aluminum aircraft links, remote control valve bodies, hydraulic cylinders, many engine parts, valve bushings, carburetor idler valve jets, valve tappet etc.—AVIATION, June, '44.

Heavy Duty Milling Cutter 53

Type "H" is new milling cutter announced by Lovejoy Tool Co., Springfield, Vt. Designed for heavy duty, cutters are of 1-in. dia., capable of taking cuts up to ¾ in. Company's locking principle is employed and blades are interchangeable. Furnished in diameters 3 to 8 in. for shell and arbor mounting and diameters 9 in. and larger for spindle mounting. Cutters can be furnished with negative cutting angles.—AVIATION, June '44.

New Power Press 54

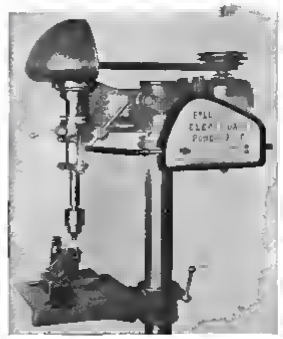
Anderson Brothers Mfg. Co., Rockford, Ill., announced a new power press with traveling ram adaptable for straightening cam shafts. Instead of moving anvils, centers, and work, ram is moved along on ball bearings. Base and hydraulic unit are same as used on Model HP 020-P with sensitive control permitting inch-



ing shaft along a thousandth at a time. First unit has 10-ton capacity. Planned is a 25-ton unit.—AVIATION, June '44.

Automatic Tapper Unit 55

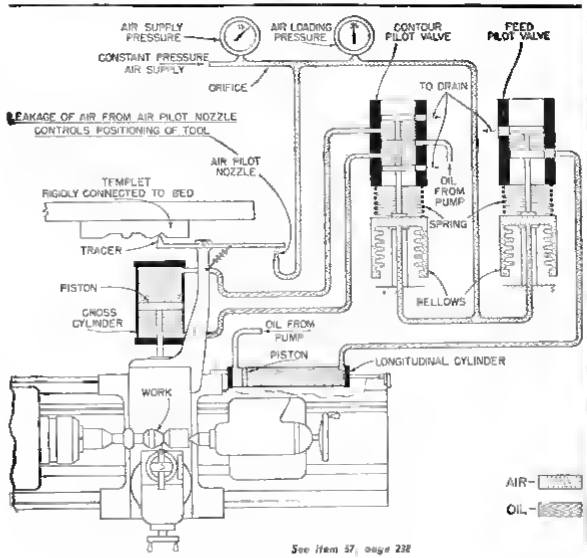
Automatic tapping with precision Class III threads is stated possible on almost any type of drill press with "Electrealrail" power feed unit announced by The Bellows Co., Akron. Power feed utilizes a solenoid controlled air motor to advance



and retract spindle. Feed and retraction speeds, independently controlled, are subject to infinite variation. Down feed is held under exact pressure at all times to prevent thread forcing. Same control of reverse feed almost "floats" tap out of piece. Operation is feet controlled. Feed may be synchronized to solenoid controlled jigs, work feeds, and fixtures to make operation automatic. May be set for multi-cycle operation with indexing fixtures and dial feeds. Stroke is adjustable to a maximum of 1¾-in.—AVIATION, June '44.

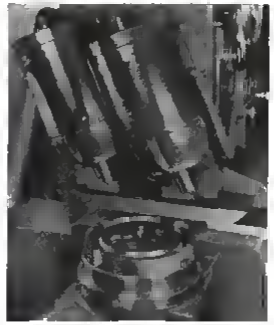
Milling Machine 55

Designed to mill notches on each side of 12 drilled holes in a stalined ring, this new machine is equipped with a rotary table which indexes automatically as cutters are retracted vertically upward



See item 57, page 238

Duplex cutter spindles and slides are mounted in a fixed angular position on a vertical slide. Shell motors are in self contained spindle heads and cutter spindles serve as motor shafts. Power traverse automatically retracts column to clear rotary table for loading. Work is held in a power clamping fixture and power traverse moves column forward until cutters are in position. Cam motion reciprocates cutters vertically, synchronizing this motion with automatic indexing on piece. After holes are slotted, cutters move to upward vertical position and column retracts to loading position, where machine automatically stops. Made by Cross Co., Detroit —AVIATION, June '44.



Contour Control 57

A new contour control (see p 247) principle of precision air measuring gages to obtain extreme accuracy in automatic operation of machine tools, has been developed by Bailey Meter Co., Cleveland. Illustrated is application to engine lathe. Unit employs a pneumatic system which scans a thin metal template and controls powerful hydraulic cylinders which position cutting tool or work. Contours may include slow and fast tapers, round corners and square shoulders. All diameters and shoulders of a step shaft may be turned with one setting of tool. Accuracy of contour control is secured by using air control system as an amplifier of motion and a source of power in transmitting movement of tracer stylus to control system. Motion of hydraulic pilot is from 25 to 100 times greater than that of stylus depending upon rate of spring used in hydraulic pilot valve assembly. A fully balanced air pilot valve permits operation of tracer stylus with from 3 to 8 oz of force permitting use of soft metal template —AVIATION, June, '44

• Announcements of new machine tools, shop equipment, and accessories are invited for inclusion in these columns. In writing, emphasis upon aviation industry applications of newly-marketed items is desirable, and wherever possible, glossy-print photos should be enclosed for illustration. Please do not send electros. Manufacturers should address New Products Editor, AVIATION, 330 W. 42nd St., New York City 18.

Shop Equipment & Accessories

Stellite-Tipped Tools 58

Especially designed for machining steel, two new Stellite-tipped tools are announced by Haynes Stellite Co., Kokomo, Ind. They consist of a cutting tip of Stellite 3432 cobalt-base alloy brazed or butt welded to a tough steel shank with proper clearance and lead angles ground for turning steel. Tools are recommended by maker for applications employing tools having large cross sections or which are bent or offset or for tool holders in which solid tool bits are impractical. Tools are also used for forming and grooving operations. They are ground with a 13-deg end cutting edge angle, a 15-deg side cutting-edge angle a 7-deg end relief angle and a 7-deg side relief angle. They are furnished with flat tops so that side rake angle may be ground for each job —AVIATION—June '44.

Torque Equipment 89

Zimmerman Products Engineering, North Newington, Conn., presents a complete line of torque equipment. Test stands are used for checking any torque device and to set torque tool to desired torque. Stands are made in two sizes—to 500-in. lb capacity also to 1,000-in lb capacity. Torque tools are made in straight handle types "T" handle models, torque tapping tools and torque screw drivers —AVIATION, June '44

Insulation Tester 60

A 7 volt ohmeggor insulation tester made by Radio City Products, New York, provides insulation testing of 500 v up to 10,000,000,000 ohms (10,000 megohms) a comprehensive electronic multitester and a capacitymeter measuring as low as 0.0000025 mfds (2.5 micro microfarads) and up to 2,000 mfds. Includes VR 105-30 voltage regulator tube and associated circuits. 13 a. c. and d. c. voltage scales measuring from a fraction of a volt to 5,000 v at very high sensitivity. Direct reading with high voltage test leads, rf lead, signal tracing probe. Vacuum tube voltmeter on all ranges. Input resistance 16 megohms max. 7 ohmmeter ranges to 1,000 megohms.—AVIATION, June '44.

Resin Tape for Plywoods 61

Split or cracked thin veneers used in aircraft may now be salvaged through use of Tego tape, states Resinous Products & Chemical Co., Philadelphia. Weatherproof. It is said that this thermosetting resin of the phenol formaldehyde type restores mechanical strength of original veneer without impairing its weather resistance —AVIATION, June '44.

Spark Plug Test Stand. 62

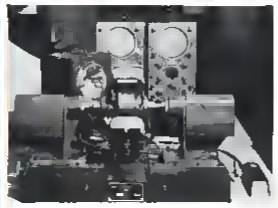
Engineered by Airplane Mfg. & Supply Co., N. Hollywood, Calif., are two new fully equipped spark plug test stands on wheels for cleaning, adjusting and testing of mica and ceramic plugs. Both stands contain either a Wheatstone bridge circuit and pressure test bomb for testing or a motor and magneto combination. To determine electrical condition, frequency and quality of spark under simulated engine conditions, a high pressure test chamber is arranged, operating with a CO_2 bottle taking pressure up to 750 lb. Mica stand provides a motor with shaft for cleaning collet and an ceramic stand a sand blaster is cleaning agent. Appropriate tools are provided for adjusting electrodes, also a large storage compartment for 432 plugs and a large tool and parts drawer are conveniently arranged. Any 110-v. a. c. line provides sufficient power. Mica stand has special built-in vise adjustable to hold plugs of any desired angle, also heating lamps in storage compartment to prevent dampness —AVIATION, June '44

Telephone Type Relay 63

This relay was specifically designed for high frequency use and incorporates Mycalex insulation, but it can be supplied with Bakelite insulation for standard switching service. Coil is cellulose acetate sealed for resistance to humidity and will withstand shock and vibration to 10 Gs, states Allied Control Co., New York. Contacts are palladium, fine silver, or special alloys. Double pile-ups of contacts can be supplied from a single "A" (SPSTNO) to "E" (SPSTNO) or "C" (3PDT) arrangement to a maximum of four "C" combinations. Weight and dimensions less contact pile-ups are 1½ in. and 1 7/16 in. by 1 2/3 in —AVIATION, June '44

Balancing Instruments 64

The dynascope balancing instruments made by **Gramley Engineering Co.**, Detroit, indicate visually extent and location of forces due to unbalance at any chosen speed, at both sides of rotating body simultaneously. Two 5 in. cathode ray oscilloscopes, one for each end of the rotating body, are used as indicating devices and to transform mechanical vibrations into a visual pattern. By



means of an electrical loading mechanism, a single revolution is impressed on oscilloscope as a straight line. Vibrations of body are impressed on this pattern to draw line into a sine wave which may be viewed at any speed, thereby defining criticals, dynamic and static, indicating phase shift between criticals and providing positive means of direct reading at any speed. Electrical equipment has a variable ratio of amplification which allows an extremely small or large amount of unbalance to be accurately measured, states maker.—**AVIATION, June '44.**

Blind Rivets 65

These rivets are designed to make it easier to handle jobs in difficult places offering only one-side access to work. A new feature is a notch in pulling mandrel, serving to inhibit flow of metal in upsetting process and making possible a shorter mandrel. **Cherry Rivet Co.**, Los Angeles.—**AVIATION, June, '44.**

Key Seating Tool 66

Made by **Topflight Tool Co.**, Towson, Md., this key seating tool is especially designed to simplify installation of deicer boot Rivnuts. It replaces broaching process, eliminating burrs, it is said, and

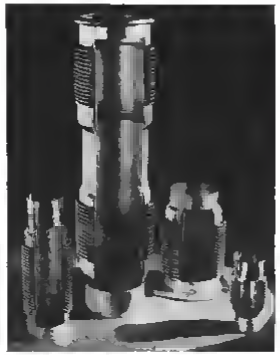
can be regulated to make a seat of any desired depth to accommodate key. Automatic pilot assures accurate placing of seat.—**AVIATION, June '44**

Bostam Motors 67

Fractional hp motors for installations requiring maximum power per ounce of weight are offered by Smalt Motors, Chicago. SM-2 models are completely enclosed with aluminum ends, ball bearings, and stainless steel shafts. Speeds are from 2,000 to 20,000 rpm, reversible with high starting torque and low current draw. Voltages from 6 to 230. Built to users' precise specifications.—AVIATION, June, '44.

Exhaust Heater 68

Chicago Metal Hose Corp., Maywood, Ill., offers various types of stainless steel flexible assemblies for aircraft use. Unit



illustrated is gasoline engine exhaust heater assembly, which is 2-in I.d. Rax-Flex close-pitch stainless steel flexible assembly with liner and special end adapter electrical-resistance welded to flexible segment. Liner is designed to prevent flame impingement on light flexible section of wall. Unit is for high temperature aircraft exhaust.—AVIATION, June '44.

Selector Valve 69

Designed for aircraft installations such as bomb bay doors, landing gear, wing flaps, etc., Adel Precision Products Corp., Burbank, Calif., announces a new solenoid operated 4-way hydraulic selector valve reported of light weight, greatly accelerated action and low current consumption. Valve measures 2⅝ x 2⅝ x 7 8/16 in. and weighs 4.3 lb. Current of 15 amps at moment of impulse automatically drops at completion of stroke to holding pull of only 3.2 amp at 24-v dc. Operates at pressures up to 1,000 psi.—AVIATION, June, '44.

Multiple Potentiometer 70

In this new multiple control, operable either as a rheostate or multiple potentiometer, a number of contactors roll upon a single resistance coil. Each of contactors is in form of a twisted bar and is insulated from other contactors to engage successive convolutions of coil to permit accurate control of current supplied without influencing current delivered by any of other contactors. Unit fits into space heretofore required for single unit of conventional design with very little increase in weight.—American Pattern & Mfg Co., Detroit.—AVIATION, June, '44.

Pneumatic Filing Machine 71

For fine finish fitting on die casting dies, plastic molds, and aircraft parts, Keller Tool Co., Grand Haven, Mich., has designed a pneumatic hand filer which may also be used as a portable power saw for making irregular saw cuts. This new tool includes rotary air motor with a new cam and piston using a ball bearing assembly to transfer rotary motion of motor to reciprocating motion of file. Air operated it is stated to be cool and comfortable to handle under heavy load. Made in one size with a free speed rating of 1,500 strokes per minute and fixed length of file stroke of 7/16 in.—AVIATION, June '44.

Aircraft Testing Manometer 72

For measuring surface pressures on aircraft being wind-tunnel tested, a special portable manometer has been designed by Trimount Instrument Co., Chicago. Device consists of ten banks of six tubes each with every sixth tube being atmospheric. Scales are made of glass with black opaque increments and numerals. Any type of indicating fluid may be used. Units are automatically positioned throughout full range of manometer by means of electric motors. Backlighting which prevents reflection of glare makes it possible to photograph readings for permanent records. Fluorescent lights illuminate scales for visual reading. Instrument is also used for studying intercoolers and aftercoolers.—AVIATION, June '44.

Taper Chuck 73

Performance of radial arm routers, widely used for high speed production of nonferrous flat sheet parts, is reported improved by use of inverted taper friction chuck. Taper chuck is designed to counteract effects of side thrust developed by cutting pressure. Features of precision machine taper of chuck and bit shank are to assure perfect axial alignment and proper centering of tool. Bit slippage cannot occur because of spring and pin unit. "Whip" of router bit is also eliminated it is stated. Patented by Oberndorf Machine Works Chicago.—AVIATION, June, '44.

Tail Wheel Assembly 74

Operating automatically, and combining steerable and full swivel features, a new tail wheel assembly for light planes is announced by Scott Aviation Co., Lancaster, N. Y. Advantages reported by maker are: Greater ease in ground handling; ship may be pushed backwards or taxied sideways without strain, sharper taxiing turns can be made, and there is effective control in strong cross winds.—AVIATION, June '44.

Cable Tension Meter 75

Goodyear Aircraft Corp., Akron, states this improved cable tension meter combines lightness with strength. Cable running length-wise through meter is deviated from its straight course within meter. Force required to bend cable is proportionate in exact ratio to tension in cable itself, and this tension is registered on dial. Incorporated is a compensating

device which adjusts itself automatically to each size and stiffness of wire measure. Has maximum range of 3,000 lb on cables up to 7/18 in.—AVIATION, June '44.

Center Lapping Points 76

For close tolerances in thread grinding and lead grinding: Gay State Abrasive

Try a few of these in your plant — see what they do on the job →

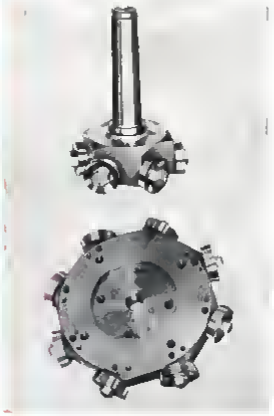
Order a trial quantity of this drill, too →

Our catalog shows complete line of aircraft tools — write for it

Products Co., Westboro, Mass., has developed Blue Finish center lapping points for use on Ex-Cell-O center lapping machines. Made in blank form. Bun shaped round and sized after mounting. It is stated that finished product is sharp, smooth-running with no hard or soft spots.—AVIATION, June '44.

Milling Cutters 77

Shearcut milling cutters have cutting bits which present circular cutting edges in a knife like manner to remove metal in a true shearing action. When a cutting edge of unit is dulled, simple rotation of



cutter a fraction of an inch without removal from machine, is stated to bring new, sharp cutting edge to bear. Each unit has from 10 to 30 cutting edges, depending on diameter. Stales maker: In removing a curled chip like a lathe tool, cutter usually leaves a finish without tool marks, often eliminating grinding or polishing. Cutter may be rotated in either direction. Manufacturer is **Shearcut Tool Co.**, Beverly Hills, Calif.—AVIATION, June, '44.

Wet Grinder 78

New wet grinder being offered by **Boice-Crane Co.**, Toledo, has a true, concentric-running 10-in. Boren quarried sandstone wheel accurately centered on its arbor so as to grind a straight bevel from wheel to edge without weakening tool temper. Designed for proper grinding speed of 1,750 rpm., grinder may be belted to a 1,750 rpm. motor, lineshaft or gas engine.—AVIATION, June '44.

Adjustable Countersink 79

Among features reported for this adjustable micrometer stop countersink, made by **Schrillo Aero Tool Eng. Co.**, Los Angeles, are adjustments in increments of .001 in. without use of tool positive lock, preventing loss of adjustments while in use; self contained knockout pin facilitating removal of taper shank cutters,

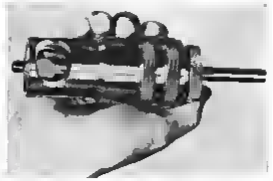
ball thrust bearing, self lubricating long life bearing, and hardened and ground alloy steel shaft.—AVIATION, June '44.

Model-Plane Motor 80

For wind tunnel test use in model planes, **General Electric Co.**, Schenectady, N. Y., announces a new engine measuring 3 x 1¾ in., rated at 30 hp. and weighing 37 lb. Rated speed is 9,000 rpm., but it can operate in excess of 13,000 rpm. Water cooled.—AVIATION, June, '44.

Large Micrometer Countersink 81

This new tool countersinks up to 1¼ in. and can countersink 12 in. rivets. Can be instantly locked at each setting in



increments of .001 in. stales maker. Adjustments are made manually and while tool is in operation. Includes interchangeable 1-in. die cutter available in 72, 78, 82, 100, 110, and 120-deg. angles with or without integral pilot. Made by Aero Tool Co., Burbank, Calif.—AVIATION, June '44.

Carbide-Tipped Tools 82

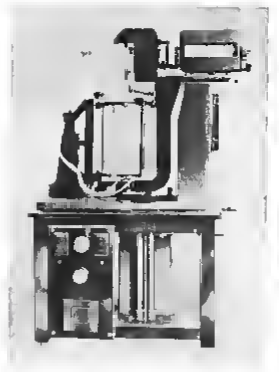
To round out their line, **Jessop Steel Co.**, Washington, Pa., announces Meltacarbide-tipped tools, made in ten styles in a wide range of sizes and three grades of tips.—AVIATION, June '44.

Battery Connectors 83

New development in quick disconnect battery connectors particularly adapted to G-1 standard batteries conforming to AN W-B-141 specifications is offered by **Cannon Electric Development Co.**, Los Angeles. Based on screw-jack principle, it is stated that this now filling speeds removal of batteries and banishes shorting and fire hazards. Large hand wheel which turns a gear and disengages battery is notched and easily operated by a gloved hand in sub-zero temperatures.—AVIATION, June, '44.

Temperature Recorder 84

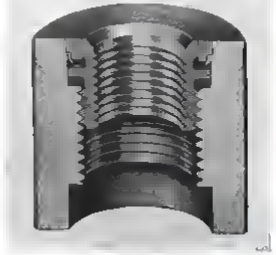
Announced by **The Bristol Co.**, Waterbury, Conn., is a new direct-reading dilatometer which records temperature, dilation changes and temperature and time changes simultaneously in ink during heating and cooling cycles of ferrous and non-ferrous metals, ceramics, and many other materials in solid form. Two records are made on a chart with rectangular coordinates for ease of interpretation and filing. Ball bearing multiplying mechanism exerts very light pressure on sample and provides accurate records. It is re-



ported. Split furnace designed for temperatures to 2,500 deg. F. can be pulled away from sample for quenching or cooling without disturbing record, and inside dimensions allow use of any size shop sample up to 1¾ in. dia. by 5 in. long. Dilatometer can be used to determine Critical points of carbon steel, coefficients of expansion of metal, thermal composition of steels, heating rates and heat saturation.—AVIATION, June '44

Hydraulic Seal Insert 85

This Rosan hydraulic seal insert, product of Bardwell & McAlister, Hollywood, Calif., is used for sealing fluid and gas



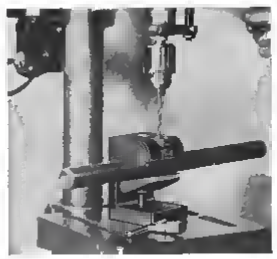
ports under pressure and has tested up to 10,000 lb. It is secured in material by a locking ring serrated inside and out. Ring engages its inner serrations with teeth of a serrated collar on insert. As ring is driven or pressed into place its outer splines broach wall of a counterbore and lock unit firmly in parent material. In unit shown, straight external threads are sealed with a synthetic rubber ring. Internal threads are provided with standard A.N.D. type seat. In case of damage to insert it may be removed by a simple drilling operation and replaced without disturbing parent material.—AVIATION, June '44.

Welder Control 86

Technical Bulletin No. 75-51-50 from Weltronic Co., Detroit, gives features, specifications and functions of the Weltronic synchronous resistance-welder control. Model 75-51-50. Reported fully automatic, all electronic, precisely synchronous and continuously adjustable, this model is designed to permit complete control of operations on spot welders using air or hydraulically actuated electrodes with solenoid operated valves.—AVIATION, June, '44.

Work-Holding Vise 87

A new vise embodying an accurate means for three-center drilling in round or hexagon stock, is announced by Universal Engineering Co., San Diego, Calif. Clamping action of vise is opposed jaw principle, leaving one surface of work clearly exposed for slot milling, etc. All exterior surfaces are precision ground square and parallel allowing vise's use in conjunction with any type of machine tool



as a work holder. There are no moving parts involved in drilling and bushings through which drills pass are interchangeable, giving a wide range of hole sizes. Bushing base is jig-bored in alignment with V seat, which is 120-deg. angle for holding either round or hex stock.—AVIATION, June '44

Generator Test Bench 88

For testing generator, regulator, and cut-out on all types of engines this generator test bench may be operated with or without storage battery. Current output from generator may be varied in 5 amp steps from 0 to 60 amp. Designed to eliminate taking battery condition into consideration when setting regulator, making possible testing of generator without regulator. Motor is 3 hp. single-phase 220-v unit with 2 speed winding—850 and 1,800 rpm. It operates in conjunction with a 6 to-1 variable pitch pulley giving a 12-to-1 speed variation. Manufactured by Lanagan & Hake, Philadelphia.—AVIATION, June, 44

Conveyor-Elevator System 89

Rex Uni-Flo is new type of conveyor for mass handling of free flowing bulk materials made by Chain Belt Co., Milwaukee. With entire cross section of enclosing casing and all space between scraper carrier flights solidly filled a continuous flow of material results. Positive discharge mechanism removes all material at point of discharge. It is designed to convey materials horizontally, vertically or at any angle.—AVIATION, June, '44

Aircraft Instrument Jewels 90

Glass Ring Jewels developed by General Electric Co., Schenectady, N. Y. for certain of its aircraft instrument bearings are also available for other applications. Listed in five sizes for use in pre-

cision measuring equipment; other shapes and sizes are possible for such applications as thread guides weighing scales, speedometers, etc. Jewels may be pressed or spun into bearing plates and other elements in same manner as sapphire rings.—AVIATION, June, '44.

Forged Cylinder Heads

(*Continued from page* 145)

centrifugal force produced by the high speed cutters would render impossible effective use of fluid coolants, and so the machines were designed to use heavy tallow fed by compressed air in a slotted nozzle through which the edge of the cutter passed. An automatic trip operated the air valve to deliver a "shot" of tallow every few seconds. This was satisfactory in so far as cutting was concerned, but very wasteful of tallow which could not be readily recovered, while the parts, being heavily coated with grease were very objectionable to handle. Experiments are now being conducted with fluid coolants with apparently successful results, and all machines will probably be changed to this in the near future.

First finning operation consists of cutting 14 fin spaces around lower part of body on a Cincinnati Hydro-Matic with the head mounted on a rotary fixture and located both on the flange and locating pin holes. The grooves are not perfectly circular, nor all of the same contour, and a master cam is used to obtain the necessary rise and fall of the machine spindle. At start of cut, cam follower travels along a horizontal plate to feed cutters in to depth thereafter it engages cam which rotates at same speed as the part and produces required profile. On this operation two cutters are employed, 0.112 in. thick, and spaced at the mean thickness of the fin which is 0.058-0.068 in. The depth of the cut is about 2¼ in. at the deepest part.

Parts are now passed to a Cincinnati Hydro-Tel for cutting 16 fin spaces on the exhaust side. As were all the fin cutting machines this was built for the particular purpose. It consists essentially of two vertical spindles each carrying single cutter operating at 4,500 fpm., and three rotary tables. One of these carries four identical sets of cams, each being a series of plates whose contours correspond to the varying contours at the base of each individual fin space. The in and out movement of the cutters is controlled hydraulically through a follower wheel held in contact with the cam. The other two tables are work tables each holding four cylinder heads.

Variable speed feed cam controls speed of rotation of parts past the cutters. For the first quarter inch of cut the feed is at the rate of 15 in./min. increasing constantly to a maximum of 70 in. A rapid traverse of 270 in./min. then brings the second head into position, whereupon the feed is slowed again to 15 in. After the fourth head has been cut the rapid traverse is slowed somewhat to allow time for the cam follower to index vertically to the second step of the cam.

A similar machine cuts the five fin spaces on the intake side of the head, after which another similar machine cuts the 38 spaces on the top.

Following these operations parts are washed and fully inspected and forwarded to a second Greenlee transfer machine. This comprises a total of 124 stations, divided into three sections, and is similar to the machine used earlier. It performs all semi-finish and finish milling operations, drills, reams, countersinks, and taps all holes, counterbores valve spring seats, finish reams valve guide holes, and forms and taps valve seat counterbores, using carbide tipped taps.

Snyder milling machine is employed for forming counterbores and blending radii inside both bosses in each rocker box. Double ended cutters carry a groove around their periphery to act as a journal, and are supported in bronze brackets. After the head has been located and clamped these brackets advance into position between the bosses, and the driving arbors are advanced manually through the rocker shaft holes to engage the cutters. From there on, the cycle is automatic, the cutters feeding to the right to form one counterbore, then to the left to form the other, and finally returning to the center to permit disengaging of the arbors and withdrawal of the support brackets.

The head is now loaded into a Hall Planetary Mill with a lead screw lock. On this machine a recess is cut at end of thread diameter and at junction of pilot diameter with dome inside head. A second machine then rough and finish mills the special modified buttress thread and the pilot diameter simultaneously, using a combination cutter to assure perfect concentricity.

Final operation consists of turning and facing flange on a Bullard Mult-Au-Matic, part being held on adapter located on buttress thread.

Except fin cutting operations and machining rocker boxes and valve ports, operations are similar to those on cast head, although automatic equipment is employed to a far greater extent than before. Machining time is considerably longer than on cast head, but is more than offset by savings by elimination of lengthy and tedious foundry operations.

Are Stock Values Real?

(*Continued from page 185*)

cut of more than $330,000 annually. No wonder C & S has petitioned the CAB for restoration of its old rate.

Some trade officials look for a period of deficits for the smaller lines after the war, others even maintain that mail rates must be raised in certain cases if, indeed, a few of these lines are to survive. It may be, of course, that the franchise values of new routes that various lines will receive in the next few years will offset the red ink on earnings statements. If such is the case, stock prices of those lines with doubtful earning power may not suffer much.

Two fundamental economic characteristics of the air transport industry are acknowledged to be the high revenue-producing power of the airplane (said to be around $650,000 per plane in 1943) and the relatively low investment in property. But there may have to be some early postwar revision here. We have already stressed the probable decline ahead in payloads. At the same time the investment in flying equipment is apt to rise. Most of the planes the airlines now use were built on the basis of prewar labor costs. Today, of course, labor costs have soared far and away above 1939-41 levels, and it appears to be national policy to maintain labor wage gains as long as possible after the war.

Then the day of transport standardization, as it has been known since 1936 with the Douglas DC-3, may soon be over for the large lines. They haven't had much experience with the big super-liners, and it may take a whale of a lot of adjusting to get operating costs and expenses in line. As a matter of fact, in these days of priority traffic, expenses have got out of hand already. And the coming growth in air transport networks, to which everyone is looking forward, may present such operating difficulties that the new routes will be a drain on earning power in the initial days of their operation.

Peacetime traffic increases will come in the passenger end of the business. Trade observers are far from being in accord on what passenger volume to expect directly after the war. Some point to the returning soldiers who will hasten home by air after their discharge. Others are mindful of the fact that government travel will quickly dry up. At any rate, airline operators generally do not share the optimism of those who predict that passenger air travel can be brought down to bus or rail coach levels. They are wondering about living costs, taxes, also equipment costs in relation to the fares they can charge and still keep in the black.

Nor do they feel that a tremendous growth in cargo traffic is just around the corner. The railroads depended upon passenger traffic for several decades for their bread and butter before freight traffic brought in their best earning power. And despite the reluctant express rate reduction of a year ago, these rates still average 70c. a ton mile as against 4c. for less-than-carload freight.

Ralph S. Damon, vice president and general manager of American Airlines, sees little on the horizon to indicate that the airlines will carry more than the perishables, specialties, samples, and emergency items where time saved can offset higher transport costs.

Leonard P. Ayres, well known economist of the Cleveland Trust Co., recently concluded (from a survey of airborne transportation covering 800 shippers) that "airlines probably will find it difficult to maintain express traffic at present volumes after the government ceases paying shipping charges on a large portion of it."

Results of the Ayres survey indicate: That the majority of these shippers will use air freight or air express after the war; that present service is highly satisfactory, except for the expense; that cost is uppermost in the minds of shippers, and that all of them will seek the cheapest means of transportation in the post-war period. It was found that the prime

reason for shipment by air generally was the speeding up of production of war goods rather than the distribution of finished products.

All these factors in the outlook have been mentioned so that the airline investor will realize that these stocks, on the basis of present market prices, are discounting future prospects that may still be quite remote.

There has been no attempt to "bear" the airlines. They are one of the best examples of a growth industry. And there is plenty of romance in their post war expansion if the stockholder is willing to be reasonably patient. Already it seems clear that with the development of efficient large-scale operation and proper ground handling the airlines will become big business in the next dozen years. And perhaps their most important asset today, though an intangible one to the investor, is the nearly a generation of experience that has been telescoped into three short years.

But don't expect the airlines to start cutting any dividend melons or exhibiting the stability of a General Motors Corp. or a United States Steel Corp. directly after the war. The airline investor had best take middle ground between the enthusiastic optimism of an airline traffic manager and the more cautious approach of an operating official.

Forming Sheet Aluminum

(*Continued from page 159*)

neck of the spun shell. It saves time where it can be used but does not allow spinning near the bottom. If an off-center chuck is used, the bottom of drawn shells may first be formed by means of a bulging operation.

Chucks for spinning are made of aluminum alloy, steel, cast iron, or hardwood, depending on the number of pieces to be spun, their size, shape, and desired finish. For quantity and quality production, the metal chuck is preferable, especially where sharp re-entrant angles are present. Hardened steel chucks with a high polish produce smooth surfaces and are most economical for products that are buffed or given a similar finish. Extremely large pieces are usually spun on wood chucks because of the economy of producing them. They can be cheaply built with laminations so that the contour is readily changed. Chucks should be wear resistant and kept highly polished as the slightest imperfection in their contour will show up in the work.

The number of tools employed for spinning depends entirely on the operator and cannot be standardized. Each craftsman is apt to develop a set that he likes best; some require a large number of tools while others use a minimum number of three. Tools can be divided into three main classifications: (1) Those for laying the metal down against the chuck, (2) those for beading; and (3) those for cutting or trimming.

A plain, flat, smoothly polished hickory stick with rounded end, is generally used by hand-spinners for breaking down the circular blanks. The half-round all-purpose steel tool may also be used to lay the metal down against the chuck. It is usually described as being half-round on the top side and flat on the bottom, but this is not exactly correct. The upper part of the tool conforms to the description, but the bottom is crowned rather than flat. The upper part of the crown is used to lay down the metal, while the under-side of the crown is used for planishing.

The beading tools are usually either the wheel type or sharpnosed tools and they are used to roll over or finish the edge of the shell. A plain diamond-shaped tool is used for cutting or trimming any excess metal. Generally, the tools are made of high-carbon steel, forged to shape, hardened, polished, and fastened in a hardwood handle. Where the shell is unusually large or the thickness of the metal is greater than approximately 0.081 in., the spinning tools are mechanically supported and forced against the work. Spinners' tools should be kept smooth and bright if they are to give good performance. They should be buffed lightly, any time they start to drag, and touched with light oil.

The proper blank diameter is found by selecting a circle whose area is equal to the surface area of the spun article. Allowances must be made in both gage and

diameter, however, since the finished article will be slightly thinner than the starting blank. This thinning of the metal results in an increase in area, which is enough to allow for the necessary trimming. The thinning of the metal can be minimized by using several breakdown operations.

Having discussed the best grades of metal to use, methods of annealing, proper tools, ways to lubricate, and correct lathe speeds, it is now possible to go through a simple spinning operation step by step. The first task is centering of the blank, which is put in the lathe as nearly centered as possible and clamped. A flat stick is held lightly against the edge of the blank, the tail stock loosened slightly, and the lathe started. (If the blank is too loose it will fly out; and if too tight, the edge will be marred.) The blank may be centered by pressing lightly against the edge, and as soon as it is in place, the tail stock is tightened. Centering on the chuck can also be accomplished in other ways, such as drilling a hole in the center of the blank or by forming a dimple at the center.

Lubricant is now applied with a dauber. With the hickory stick the blank is laid back against the chuck an inch or so to "set" it. This gives an extra grip to hold the piece in place, and in progressive steps the metal is worked down on the chuck. It is better to start with a slow lathe speed rather than one too fast. If the speed is too great, centrifugal force will make the blank stand out from the chuck, and so much tool pressure will be required that excessive thinning or possibly rupture will result. After again lubricating the laid-back blank, the half-round tool is used to work back over the contour of the chuck from the tail block.

The contact point of the tool should touch the work a little below the center. Steady control is maintained by placing the tool on the tool rest, bracing it against the fulcrum pin to obtain leverage, and gripping it with the free hand. If the tool remains in one place too long it will cut a ring in the surface. On the other hand, moving it too fast will produce ridges. Working the tool continuously from the center out will thin the metal to the breaking point so it is best to work the tool back and forth in a very short radius, with the arc being not more than an inch or two on either side of the pin. The pin should be moved frequently and the tool kept at right angles to the point of contact.

The whole body is used to apply the tool to the work, not just the arm. Experience is the only way of learning the right amount of body pressure; too much pressure will wrinkle the metal or cause the tool to break through. As stated, the skilled operator feels the metal "flow" under the tool and is able to detect any wobble if the work gets out-of-balance. Annealing will improve the metal's workability if it becomes too hard to flow properly.

A narrow flange is left on the outside of the shell at all times, even up to the final trimming operation. The flange should be kept headed in the same direction as the metal is being worked or it

will be very difficult to straighten out. If wrinkles appear in the flange and are not too bad, they can often be worked out with the tool by holding a smooth hickory stick (called the "backstick") solidly behind the wrinkles. If this method fails, the spinning should be taken from the chuck and the flange hammered smooth.

After the breakdown operations are all completed, a final spin is made to lay the shell tightly against the chuck, starting at the tailstock and working outward. The metal should never be loose at any point. If the metal is not tight against the chuck, it makes a hollow sound when tapped with a wooden mallet. It is almost impossible to lay a loose intermediate section to the chuck if there is a tight fit at both ends.

In the trimming operation, the edge is turned back slightly and the trimming tool is held lightly but firmly against it. If beading is desired, the flat tool is placed on the right side of the rim and the curl is started for the bead with the hickory stick. The edge may now be rolled entirely over, using the beading tool to finish the job.

After all operations are completed the shell is removed. In case it sticks to the chuck, it should be given a "once over lightly" with the planishing tool as it spins.

Intermediate chucks may be used to break down a blank if the shape is too severe to form in one spinning operation. A typical example is the end of an airplane fuel tank. It may first be partially formed in a regular draw press in one or more operations, then brought to the lathe for spinning. Because of the thickness and temper of the metal, a helper is needed to add his weight to the spinning stick. Since this tank must be spun so near the end, a series of different size tail blocks are used to provide an increasingly better grip on so large a shell.

The number of spinning chucks (or the number of reductions) depends on the shape of the finished product, as well as upon its diameter compared with that of the blank. In general, shells with perpendicular sides require more chucks than those with sloping sides.

After spinning, hemispherical shells will have a flat bottom equal in diameter to that of the back-up block. This can be hammered out to whatever radius or shape is required.

A form of spinning requiring highly skilled artisans is called 'spinning on air." A straight-sided shell, either spun in the usual manner or drawn, is inserted in the lathe. The operator does not use a chuck, but merely uses the tool to form the desired shape. This method is often resorted to when close dimensional tolerances are not essential. The work must be frequently checked against a template.

Aluminum sheet in thicknesses from 0.025 to 0.081 in. is usually spun by hand although metal thinner than 0.025 in. can be spun with special care. Metal of greater thickness than 0.081 in. is usually spun by semi-mechanical or entirely mechanical methods.

The semi-mechanical method differs principally in the application of the tool to the work. Two hand-operated feed screws are used to control the motion of the tool. The right hand feed controls the longitudinal movement, while the left hand feed moves the tool in and out, following the contour of the chuck. This method takes less strength than hand spinning but requires considerable skill.

In the entirely mechanical method the tool is rigged up to travel automatically back and forth the length of the shell. Compressed air advances the tool step by step as the work is being pressed tightly against the chuck.

Some giant mechanical spinning lathes are capable of accommodating seven foot blanks. In lathes of this type, highly polished steel shoes or forms serve as the tool and are applied to the work by hydraulic pressure. A mechanical variation of "spinning on air" has idler rolls which operate against the metal in opposite directions. These rolls take the place of the forming tool.

Parks Student Airline

(*Continued from page* 183)

of the student captain. Another task of the radio operators is to send and receive all the reservation, load, and dispatch messages. They receive requests for space from the traffic representatives to be sent to the other stations along the line.

Two radio booths are utilized for this purpose. One operator sends the message via radio telephone or code to the operator in the other booth representing the other station. This operator sends the reply, either confirming or refusing the request for additional space. Regular interline and intraline code words are used for these messages.

Students serving as the traffic representatives handle all requests from the student passengers seeking reservations. Many problems are presented in this manner and the passengers are encouraged to present those problems that will best demonstrate the ability of the sales personnel. Using standard airline guides and tariff regulations, fares and schedules are quoted to the passenger with a minimum of delay.

Working in connection with the sales people are the students acting as space control operators. Master charts are prepared showing the space assignment for the various stations along the route, and each salesman must secure his space from control before he can confirm it to the passenger. Patterned after the space-control system of one of the largest airlines in the country, this department is responsible for maintaining an accurate check on all space sold, released, or acquired from other stations.

Direct telephone connections between this department and the sales desk assures instantaneous and positive service. After the flight has left the station, these men will prepare the necessary space-release messages and see that they are sent to the next station for possible sales there.

One of the busiest departments of any airline is the ticket counter, particularly

at flight departure time. PACA is no exception. Staffed by students with training in the issuing of tickets and passenger handling problems, this department functions as smoothly as any airline ticket counter ever functioned. Student passengers who hold reservations are checked in 10 min before flight time and are then issued their tickets. Passenger manifests are prepared, and the passenger's baggage is weighed and tagged. Excess baggage charges are collected at the rate of 0.5 percent of the published one-way fare, plus the government tax of 3 percent. Students serving behind the counter are faced with all of the regular problems that confront the airlines today.

Priority passengers and passengers who have been removed for priority, are handled with tactfulness. A daily report is made of the passengers who have been removed to accommodate a priority passenger, and the Station Manager sends this passenger a follow-up letter explaining the priority system to that passenger. Each clerk at the ticket counter has his own supply of tickets and a cash drawer containing a sum of stage money. At the end of each day's operation he is required to balance out his tickets and cash in the same manner as required by the major airlines.

Helping out at the ticket counter and on the ramp is the passenger agent. This student aids the passengers with their problems and sees that their baggage is turned over to the cargo department for handling. It is his duty to check on the status of all the passengers and decide whether or not they shall make the trip. He also serves as the Steward of the flight, in that he checks in the passengers at the airplane during the boarding operation.

After the passenger's baggage has been weighed and checked, it is taken to the cargo department by the passenger agent. Here the cargo handlers sort it out for the proper trips. The cargo agents are also responsible for the mail and express load. Dummy packages prepared by the students are presented for shipment via air express and the agents prepare waybills and collect the necessary charges. Serving as the Airmail Field Office, the cargo department also originates dummy airmail pouches for shipment. These students have studied the latest airmail regulations so that ample protection is given the mail. The preparation of the necessary mail forms—the 2702 and 2715 sheets—is also handled by the cargo agents. When the students have completed their cargo load forms, they are turned over to the station agents for the completion of the master load computation form.

The station agents are responsible for seeing that the gross weight of the airplane is not exceeded. They use a form similar to those provided to the regular station agents for this work. They must see that not only is the proper load carried but also instructions for the proper loading of the cargo are carried out.

Another of the duties of the station agent is to make sure that the clearance form is prepared as far ahead of flight as possible. Working in connection with the flight superintendent these station agents

originate a flight clearance and weather form that is identical to the standard type. These same employees will also prepare the load and dispatch messages necessary after the flight leaves the station. Their duties on the ramp include giving the arrival and departure announcements over the public address system and signaling the airplane to and from the ramp.

On each flight, only two student passengers are carried. While 21 seats are "sold," only two can make the flight because of the size of the airplane. These two students, however, do not sit back and enjoy the trip as regular airline patrons. One acts in the capacity of Navigator; the other as Trip Meteorologist. The Navigator maintains a complete navigation log of the trip and must keep the Captain informed as to the flight's progress.

With a background of nine months of study in navigation that even includes celestial navigation, this student is now given the practical experience his classroom work has been qualifying him to handle. The trip meteorologist is given a chance to observe just how accurate his forecast was. This is an interesting experience, for after the first few flights he is well aware of the problems faced by the captain on his trips.

When the trip reaches the other end of the run, the flight agents will open their sealed orders that have been carried on the trip. These orders contain the necessary information for working the return trip. When the flight starts back after approximately a 3 hr. stay all the forms must again have been completed by the flight agents and the flying crew assigned to that run.

Upon the arrival of the flight at the home base, the station again functions exactly like any airline working a trip in. Arrival announcements are given by the station agents, and the unloading of the airplane is as carefully carried out as was the loading. Passengers claim their baggage at the terminal building, and the "airport car" leaves for downtown St. Louis immediately.

The line mechanic, also a student, holds his airplane and engine licenses and is responsible for the mechanical condition of the airliner. His work begins early in the morning with the pre-flight inspection of the airplane, and it ends only after he has completed his evening inspection. Orders issued by the Flight Superintendent for the gassing of the airplane are given the mechanic as soon as he checks in at the airline office on the morning of flight.

On days when weather cancels out an actual flight, a theoretical flight is made to one of the cities, with all of forms prepared in the same manner as if the trip were flown. On days when flights are not scheduled, time is spent in going over the previous operations and analyzing the difficulties encountered by the student "employees."

The position of station manager, which has already been mentioned, carries its share of responsibility and the student holding this important position must maintain his station on a business-like basis. Working directly with the operations

manager (the position held by the airline instructor) he checks on each day's operation and prepares a progress report on each employee. On his recommendation, students are advanced to new positions in the same manner that promotions are granted with a regular airline.

All in all, the operation of the Parks Air College Airline follows, as closely as possible the operation of any domestic airline The young men receive practical training that really could be called an apprenticeship for the airline career field.

It is to the credit of the students that PACA has maintained a perfect safety record throughout the 10 yr. of operation and that the percentage of trips operated is very high These facts, coupled with a 100 percent load factor, emphasize the point that PACA is an important educational project for the air age

Cellulose Acetate Plastic

(*Continued from page* 149)

tensile specimen, and a 45° helix in the torsion specimen, and there was no evidence of local "necking-down" in the tensile specimen. The modulus of elasticity in tension was about equal to the average modulus of elasticity observed in the compression tests and the modulus of elasticity in shear was about 1/3 of that of the tensile modulus.

Poisson's Ratio

No tests were made to determine Poisson's ratio, μ, by direct measurement and the values of modulus of elasticity in tension and in shear were not accurate enough to calculate Poisson's ratio from elastic theory with good precision.

However, the following results were obtained: The elastic theory gives the relation—

$$\mu = \left(\frac{E}{2G} - 1\right)$$

where E is the modulus of elasticity in tension (or compression) and G is the modulus of elasticity in shear. The value of μ was about 0.53 to 0.56, depending on whether the modulus E was obtained from the compression or the tension test. This value is a little larger than the theoretimaximum value of ½.

Effect of Testing Speed on Tensile Properties

Another series of tension tests performed at an earlier date showed the effect of speed of testing for a wide range of testing machine speeds. The data for these tests are shown in Fig 9, in which are plotted the upper yield point, the lower yield point, the fracture stress, the reduction of area, and the elongation in 2 in (measured at the instant of fracture) as functions of the no-load head speed of the testing machine. The no-load head speed was used here for convenience

The reduction of area is the final area of cross-section expressed as a percentage of the original area, and the elongation is the change in length at time of fracture of an original 2-in. gage length expressed

as a percentage of the original gage length.

Fig 9 shows that the upper yield point, lower yield point, and fracture stress all increase with increasing head speed until a critical speed is reached at about 1 5 to 2 in per min, beyond which they remain substantially constant. There was also an indication that both reduction of area and elongation decrease with increasing head speed.

Aging

A comparison of the results of the tension tests reported above with the tests reported in the first section for the same material shows that the strength of the material has increased with age The age of specimens at time of tests reported above was about 2,000 hr (taken from the start of the investigation), and the age at the time of the tension tests reported in the first section was about 11 000 hr. During this time interval of 9 000 hr the upper and lower yield point increased about 4 percent at the rate of strain of 0 0016 per min and about 8 percent at the rate of strain of 0.04 per min The fractnre stress increased about 12 percent for both speeds and the strain at fracture increased about 4 percent An increase in the modulus of elasticity of the specimens— about 15 percent—was also observed.

Effect of Transverse Hole On Tension Test

Tensile specimens containing a circular transverse hole of 0 082-in dia., as shown in Fig 1d, were tested in tension to determine whether the tensile properties of the material would be affected by the stress concentration or the stress gradient resulting from the hole

Specimens were tested at three different head speeds, which resulted in rates of strain (measured over a 2-in gage length) equal to the rates of strain used in the tension tests measured above Readings of load, deformation, and time were taken throughout the tests, and from these data the rate of strain in a 2 in gage length and the average stress at fracture were determined. The stress-strain diagram for the specimens with the hole differed from that for the solid specimens in that no yield point was observed. The load increased continually to a maximum value at which fracture took place. Total extension of specimens with a hole (as measured over a 2-in. gage length) was only about 8 percent of the elongation of the solid specimens.

The ultimate strength was computed by dividing the maximum load by the net cross-sectional area at the hole. At a rate of strain of 0 04 per min the ultimate strength was 5,090 psi ; at a rate of strain of 0 0077 per min the ultimate strength was 4,350 psi ; and at a rate of strain of 0 0016 per min, the ultimate strength was 3 920 psi

As in the case of the other tests, the effect of increasing the rate of strain was to increase the ultimate strength The corresponding values of ultimate strength for unnotched specimens were 5,520 psi , 5 000 psi., and 4,490 psi Comparing these values with the values for the specimens

containing holes, it was evident that the hole resulted in a decrease in ultimate strength of 8 to 13 percent.

Cause of this decrease may possibly be explained as follows. The fracture in a tension test of a specimen without a hole occurred on a plane at right angles to the axis of the specimen. Thus failure resulted from separation of the material under a tensile stress, starting usually by a small fissure at the surface of the material. In tests of the specimen with the transverse hole, it was observed that all of the plastic deformation occurred in two wedge-shaped areas starting at the hole and spreading fan-like to the sides of the specimen. Under this condition the deformation was approximately uniformly distributed over the cross section of the solid portion of the specimen so that the total axial strain adjacent to the hole was much greater than that at the sides of the specimen where the amount of plastically deformed material was the greatest.

Thus the stress distribution was not uniform during plastic extension at the cross section containing the hole—i. e., the stress gradient was not zero. Stresses were much higher near the hole than at the sides. Since failure occurred by a crack starting at the hole and spreading rapidly when once formed, one might conclude that the average stress at the time that a crack started in the specimen with the hole was less than the average stress which caused a crack to start in the solid specimen. Thus the ultimate strength of the specimen with the hole would be smaller than the ultimate strength of a solid specimen.

Engine Production

(*Continued from page* 151)

ring to produce a more severe oil scraping action. This, in turn, greatly reduces oil consumption.

Chamfering also prevents rapid increase in the width of the land as the rings wear to a seat during the breaking-in period. It is now possible to operate engines a full 800 hr. before oil rings must be replaced, whereas formerly rings had to be replaced after about 500 hr.

"Setting" Time Decreased

Outside diameters of compression rings were formerly ground to produce a smooth surface. This was found to result in severe wear during run-in and in earlier feathering of the edge of the ring, ultimately resulting in failure of lubrication of the bearing surface of the ring. Accordingly, experiments were made using a turned, rather than ground, surface. It was found that the minute valleys left by the turning tool afforded space on the ring bearing face in which oil is held. This thread-like diameter reduces the area of ring contact with the cylinder, thus decreases the time for "setting" or wearing in the ring to a proper surface. Fig. 8 details how the ring surface is now finished.

To avoid the use of stock of large diameter and the milling of a hex head on a carburetor hold-down bolt having a flange under the head, the flange was made as a separate piece and brazed to the under side of the head. This bolt (Fig. 9) is now produced in one piece from stock only slightly larger than shank diameter, both the head and the washer being upset in a cold header. Only enough excess stock is left for grinding to secure the high grade finish required. The thread, which is a class-3 fit, is rolled, since this affords a smoother finish than a cut or ground thread and yields a thread well within the close tolerances specified. A small radius is left where the flange joins the shank.

Cold headed bolts of this type possess ample strength and are produced with virtually no waste of stock. Naturally the bolts cost much less than those machined from bar stock. Also a more favorable grain flow results from the upsetting action.

In Fig. 10 are shown the old and new methods of fastening the scavenging and vent pipes to the reduction gear housing. When, in the old method, the pipes were rigidly fastened, breakage of the pipes sometimes occurred in assembly. But in the new method, fittings are threaded and have above them Neoprene washers which provide a degree of flexibility. The result is to eliminate breakage in assembly.

Carrier-Based Aviation

(*Continued from page* 111)

gear was a friction drum development which controlled the runout. This resulted in a considerable saving in weight always an objective of prime importance.

This improvement was incorporated first in the converted *Saratoga* and *Lexington*, then in the *Ranger*, the first ship to be built from the keel up as a carrier. Paralleling the development of the modern airplane has been the development of the ship's arresting gear and other facilities, which have led to our present highly perfected carrier.

The modern airplane, with its increased speed, however, requires greater strength for arresting. The use of catapults also calls for additional structural weight necessary to absorb catapulting forces. As the efficiency of the plane improved, the problems of adapting it to the carrier increased. The solving of this multitude of technical problems is an impressive story. For security reasons, however, it can not be told in detail until after the war.

Aeronautical science has reduced the carrier plane's handicaps. Skillful design has been perhaps the most important factor. The wing is clean and lines are trim. All materials are carefully chosen to keep the weight as low as possible, yet to provide sufficient structural strength. New developments in engines and propellers also have been major contributions.

The Navy wing is carefully designed. In spite of its mechanically folding feature, the wing easily withstands the high pullout forces resulting from dive bombing and fighter tactics. Dive bombing has been found to be particularly effective against ships. In this type of attack Navy pilots plunge down a vertical flight path to deliver their loads of destruction. The *Dauntless* and the *Helldiver* have become the terror of enemy shipping. The *Avenger* is unsurpassed as a torpedo bomber. It is designed to close with the enemy at high speed and at low altitude in order to launch a torpedo before the target ship can maneuver to avoid it.

As a result of engineering skill, many of the carrier plane's limitations actually have been converted into assets. Our modern plane closely approximates the speed of the land-based plane. The larger wing affords maneuverability in the air, permitting a tighter turn. This is particularly advantageous in close-in fighting, if tail chase tactics are used. Navy planes have a smaller turning radius, which brings them inside the opponent, and in position to give a deadly burst of gunfire.

There are other features on the profit side of the ledger. All carrier air operations are made from sea level; thus wings, engines, propellers, and instruments can be designed with the knowledge that there will be no variation in the altitude of the "flying field." Take-offs never need be made in a flat calm for the carrier can generate wind by its own forward speed. Heavily loaded planes can be launched at satisfactory flying speed by employing the carrier's catapult.

The modern carrier has been developed into a compact, efficient and highly mobile airbase, with excellent airplane operating and repair facilities. These include communications, weather information, fuel, ammunition, spare parts, and, a feature which promotes the efficiency of combat aircrews, clean, comfortable quarters with wholesome food served in the manner of an American home.

Admittedly, airplanes which operate from carriers must have features in their design which tend to place them at a disadvantage in comparison with planes operating from shore bases. With these features skillfully designed, however, the penalties are almost negligible. The compensations are evident when one sees in action the tremendous concentration of mobile air power in our modern carrier task forces.

Review of Patents

(*Continued from page* 195)

Multiple-Container Chute Rig provides for separate containers covering range of required paratroop equipment, to be arranged on appropriate launching device for dropping in series by a single parachute. Launching "trap" in plane would also serve as a loading means.—2,346,016, filed Apr. 25, 1942, patented Apr. 4, 1944, F. G. Manson and J. J. Maskey, for free use by government.

Aerial Delivery Gun Container relates to chute-borne housing for rifles or machine guns. For protection against severe shocks special end bumpers are provided. Container is cylindrical, with intermediate radially disposed partitions forming a number of gun compartments.—2,345,916, filed Apr. 25, 1942, patented Apr. 4, 1944, F. G. Manson and J. J. Maskey, for free use by government.

Landing Gear. Here two main landing wheels are in normal position while third wheel is disposed at rear, either beneath tail or between tail and main wheels. Arrangement is such that aircraft can be landed in position approximating normal level flight as distinct from tail-down position. Third wheel can be raised if required—for instance on trainer craft when it is desired to instruct a pupil in tail-down landings or take-offs.—2,345,619, filed May 18, 1942, patented Apr. 4, 1944, L. E. Cowey.

Retractable Undercarriage Mechanism. This patent relates to undercarriage comprising two wheels, supports on which wheels are carried, bearings for supports, and driving connection between plane's propellers and the supports, change in line of thrust of propellers after takeoff would rotate supports, swinging wheels into retracted position; another change in thrust of aircrews at time of landing would similarly move undercarriage wheels into landing position.—2,349,280, filed Apr. 2, 1938, patented Apr. 13, 1944, R. Tampier.

Illuminated Landing Field. Without use of any superstructure or any parts projecting above level of landing surface, an illuminated landing field is here provided by use of sub-surface lights sending rays up through translucent materials employed in field surfacing. Invention treats of materials for this use which will be resilient and resistant to both skidding and breakage.—2,348,385, filed May 20, 1940, patented Apr. 11, 1944, E. C. Henderson and G. Stallard.

New Bomb Rack, having means for supporting a plurality of bombs in designed for dropping from plane with bombs still affixed, means being provided for automatically releasing bombs from rack after latter has fallen a predetermined distance. Firing mechanisms for individual bombs are released only after rack has dropped away from plane.—2,240,494, filed Dec. 3, 1940, patented Apr. 11, 1944, G. H. Leland.

Propeller Fabrication. Instead of forming propeller's intermediate portion of solid mass of material, this patent calls for channeling of material from hub part way outward to reduce weight and accordingly provide airscrew which has substantially similar thickness in its various portions.—2,345,852, filed May 27, 1939, patented Apr. 11, 1944, R. C. Bretz.

Undercarriage. This gear has special means for locking it in "down" position. There is also provided a novel support for oleo strut, upper end of strut being fitted into rotatable cross beam supported by two fixed bearings. Hydraulically operated crank on one end of cross beam rotates beam to retract strut. A drag strut has one end attached to oleo strut while other end is supported by trolley on track.—2,340,797, filed Apr. 18, 1941, patented Apr. 18, 1944, J. H. Stephens, assignor to The Glenn L. Martin Co.

Integral Armor. Invention embraces concept of making basic structural members of airplanes out of armor plate to enable such parts to afford protection while serving in their ordinary structural capacity. Considered are such structures as wing beams and bulk heads.—2,346,909, filed Sept. 20, 1940, patented Apr. 18, 1944, R. J. Woods, assignor to Fell Aircraft Corp.

Airplane Safety Chair provides automatic restraining means to retain a person in his seat, but permitting him to rise upon removal of his weight from seat. Structure includes pair of opposed gates pivoted to seat frame. When occupant seats himself, gates fold over his lap.—Occupant may then lock gates.—2,348,971, filed May 25, 1941, patented Apr. 18, 1944, G. Provenzano.

Airplane Exit. Particularly for cabin type craft, invention offers special means for emergency exit of parachute-provided occupants during flight. Fitted is special door which, in emergency, may be made to pivot on downstream edge rather than

conventional upstream edge. Accordingly forces of slipstream will swing door outward, until it is blown completely clear of airplane—2,340,077, filed May 3, 1941, patented Apr. 18, 1944, S. S. La Shu, assignor to Bell Aircraft Corp.

Aerial Delivery Container. For paratroops this container is in form of a small wooden closet with sheet metal bands: one at top edge, one at bottom edge, and with U-shaped sheet metal strap extending across bottom and up sides. This strap being secured to top and bottom bands. Parachute attachment means is provided at top of container. Door in front of container slides vertically in sides.—2,347,205, filed Aug. 9, 1942, patented April 25, 1944. W. L. Lindsay and H. Wilson, for free use by government.

Non-Stall Plane. Offered is design for craft stated to afford glide-angle control providing greater inherent safety for novice and amateur flyer. Craft calls for special construction to make stalls spins or excessive dives impossible, either intentionally or nonintentionally.—2,347,230, filed Dec. 19, 1938, patented Apr. 25, 1944. D. R. Zuck.

Laterally-firing Bomb. This bomb is filled to fire a series of bullets radially so that a wider area may be covered by destructive action. Bullets are shot electrically (via battery) as bomb descends.—2,347,279, filed May 20, 1941, patented Apr. 25, 1944. S. J. Piut.

Book Reviews

(*Continued from page* 195)

CELESTIAL NAVIGATION, by Walter Hasel. Whittlesey House, N. Y. 284 pages, graphs, appendix, solutions. $3.25.

Primarily a manual with emphasis placed upon problems rather than theory. Method of approach is to take the reader on imaginary flights in which position is determined by celestial fixes. Author uses three methods of celestial fixing (H.O. 214, Weem's Star Altitude Curves, and H.O. 211) in finding solutions. Book is entirely self-contained in point of its subject, no other texts or tables being necessary for solutions.

PRACTICAL ANALYTIC GEOMETRY WITH APPLICATIONS TO AIRCRAFT, by Roy A. Liming. The Macmillan Co., N. Y. 393 pages, graphs, appendix, tables, index. $4.50.

Study of the application of analytic geometry to a practical mathematical definition of airplane contours and surfaces. Prepared for plane designers, the book's main body is divided into three parts. Part 1 analyzes the applications of analytic geometry in two dimensional space. Part 2 develops the application of rectangular coordinates to three dimensional space, and Part 3 develops and applies a system of analytic analysis to curves commonly required in the lofting of streamlined bodies.

AIRCRAFT INSTRUMENTS, by George Ellis Irvin. McGraw-Hill Book Co., N. Y. 607 pages, illustrations, appendix, index. $5.

Revised and enlarged edition. The subject matter has been amplified particularly in chapters touching on electrical type thermometers and temperature gages and other electrical instruments and meters, the vapor pressure manifold, the Weston A.C.-D.C. tachometer, synchronizer circuits and instruments, Kollsman RP indicator, Kollsman accelerometer, Pioneer Magnesyn compass and fuel flowmeter. Emphasis has been placed on the exposition of electrical instruments because of the trend in that direction."

BASIC AIR NAVIGATION, by Elbert F. Blackburn. Whittlesey, N. Y. 309 pages, illustrations, computer charts, index. $4.

Analysis of the navigator's problems from alpha to omega, all phases of which are covered in the actual order encountered in practice. The approach is graphic, with problems reduced to their lowest common denominator. Highly comprehensive, with most impediments to a practical grasp considerably modified.

AIRPLANE MAINTENANCE, by John E. Younger, Allan F. Bonnalie, and Nairne E. Ward. McGraw-Hill Book Co., N. Y. 361 pages, illustrations, appendix, index. $3.

For the civilian and military repair station mechanic. Consideration of planes and plane repair materials and how they are worked and applied comprise the greater part of the book. There are also chapters devoted to theory and to the mathematical aspects. Profusely illustrated. Minute detail, particularly on safety factors, is a welcome one.

ROCKETS, by Willy Ley. Viking Press, N. Y. 287 pages, illustrations, notes, addenda, bibliography and index. $3.50.

The story of the rocket from its earliest stages, through present-day status, and on to a projection of its possibilities. Emphasis is placed upon the importance of early Russian and later German work. The author is qualified on the subject due to his consultant with the progress of the rocket propulsion idea, partially in Germany. He discusses the background of the rocket motor thoroughly, then states the case for its successful application.

ATLAS OF GLOBAL GEOGRAPHY, by Erwin Raisz. Harper & Bros., N. Y. 63 pages, colored map illustrations, charts, graphs. $3.50.

A new approach to geography, designed for the standpoint of the air age. Maps in the book give fresh viewpoints. Much of the material is statistical, but resemblance to usual atlases end there. Intent is to give "a plane's eye view of tomorrow's geography."

ENGINEER'S DICTIONARY (Spanish-English). Wiley, N. Y. 423 pages.

With South America, a continent largely traveled by air, coming closer to us through air transport, this dictionary will be found valuable by both South and North American plans engineers with an eye on the future.

AIRCRAFT ANALYTIC GEOMETRY, by J. J. Aguilegru and L. J. Adams. McGraw Hill Book Co., N. Y. 281 pages, illustrations, appendix, tables. $3.

A new approach to special problems arising in the engineering lofting and tooling of aircraft. Basing their presentation upon ideas and mathematical methods developed in Douglas' tooling division, the authors have presented a complex subject in simplified and self-explanatory form.

ANGULAR SPACING TABLES, by Dr. Werner F. Vogel. Vinco, Detroit. 233 pages of tables. $10.

This book presents mathematical angular spacing tables to conform with the accuracy of modern mechanical devices. Calculations and formulas are given "at a glance."

WINGS AFTER WAR, by S. Paul Johnston. Duell, Sloan and Pearce, N. Y. 129 pages. $2.

Survey of the postwar aviation from the viewpoint of the average man, the job-seeker, and business interests. The book coldly appraises the chances for an expansion of aviation, giving glimpses into the possible future. Though optimistic, the author keeps close to the debonking line.

STICK AND RUDDER, by Wolfgang Langewiesche. Whittlesey House, N. Y. 389 pages, illustrations, index. $3.75.

A study in the direction of an exact analysis of the art of flying. Treatment and method are from the standpoint of the imagination coupled with common sense. Visual and graphic images are projected as a means of giving the student a precise picture of the problems he must solve. Langewiesche speaks with authority and from experience.

MARINE AND AIR NAVIGATION, by John O. Stewart and Nasten L. Pierce. Ginn & Co., Boston. 422 pages, illustrations, graphs, plates, tables, star charts, index. $4.50.

Presented as a 'compleat' navigator with emphasis on the unity of navigation and aviation. Piloting—charts for sea and air and map projections—is set forth in detail. Celestial phases of the subject are happily freed from unnecessary astronomy, though astronomy is appended for those desiring it. Treatment is accorded to relative motion, drift problems, radio navigation, azimuths, historical navigation and countless other angles. Star charts and colored maps are designed with an eye toward visual clarity. The volume offers numerous cases in point and valuable hints.

CALCULUS REFRESHER FOR TECHNICAL MEN, by A. A. Klaf. Whittlesey House, N. Y. 431 pages, formulas, appendix, logarithmic tables, index. $3.

Essentials of the subject are developed by means of questions and answers. The book is divided into customary sections, first on differential calculus, secondly on integral calculus, with inclusion of an introduction to differential equations. Final third is devoted to applications of calculus to the various fields of technology. Answers to problems are provided in the appendix.

FUNDAMENTALS OF MECHANICAL INSPECTION. McGraw Hill, N. Y. 179 pages, illustrations, glossary, index. $1.75.

Covers the how and why of inspection in its field, with a full discussion of the principles and uses of fine tools and precision instruments. The book is directed primarily at trainees and junior inspectors.

AIRLINE TRANSPORT PILOT RATING, by Charles A. and Allan C. Zweng. Pan-American Navigation, Hollywood. 493 pages, illustrations, tables, review questions. $4.

Airmen seeking transport pilot ratings may bone up here. Subjects prepared and illustrated for study include aeronautical meteorology, aircraft instruments, radio aids, radio compass navigation, instrument landing systems, and Civil Air Regulations, the latter covering airport traffic control procedures and scheduled air carrier rules. Timely and comprehensive.

MIRACLES AHEAD!, by Norman V. Carlisle and Frank R. Latham. The MacMillan Co., N. Y. 288 pages, index. $2.75.

Considers modern science as it applies to everyday improvement in lives, living, and business. A plethora of detail in research and production grouped under general headings such as housing, cars, global transportation, electronics, and synthetics, with overwhelming emphasis on the latter. Frequently ramshackle, the volume is frequently on the optimistic vision side.

Future of Aviation Technology

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in these cases, as with the airplane the shipments must be delivered to the carrier and taken away by motor truck. This means that the pick-up and delivery costs may be considered nearly the same.

These cost points, together with those for air and LCL freight, establish a significant curve by means of which we can judge further availability of air cargo business. There is a very important advantage which rail carriers have and will continue to maintain. Rail service comes within convenient distance to over 95 per-

cent of the population in the United States. The number of all purpose and medium-sized airports will be increased from 280 to more than 3,000 according to present authorization. This construction program will enable air service to reach nearly all of the 3,646 towns of over 2,500 or more persons, but the population having direct access to air transportation will remain far lower than the number served by rail.

On the other hand, off-airline shipments by air showed a more rapid increase than on-airline shipments. But in selecting air transportation, these shippers probably were seeking a time saving advantage since the cost to them must have been greater than for an all rail shipment. The favorable increase in off-airline cargo business is probably limited, and the total cargo available will no doubt be established at the tonnage where time saving ceases to be the major consideration and beyond which cost is the dominating factor.

The curve of Fig. 3 indicates that air express charges must be drastically reduced if any substantial increase in traffic is to be realized. A reduction from 58.8c. per ton-mile to 16c. should multiply air cargo by 300, considering that the advantage of time saving will remain with the airplane at the same time that the cost is lowered. If a rate of 12½c. per ton-mile were profitable, then a substantial part of the standard railway express business would be taken by the airplane with its superiority in speed, the advantage of wider community coverage remaining with rail express. However, this low rate is not probable within the near future.

Refraining from looking through any rose colored glasses, the possibilities appear to be that airplane technical improvement may permit carrying cargo at charges on the order of 15c. to 20c. per ton-mile. This should produce a traffic between 400,000,000 and 600,000,000 ton-miles in a peacetime year, a not inconsiderable advance over the 2,700,000 ton-miles transported by air in 1940.

Our problem is to see if air transportation costs can be lowered sufficiently to make it attractive to shippers. These possibilities, within known or predictable technical limitations, will be examined in the forthcoming articles of this series.

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American Air Power Policy

(*Continued from page* 112)

the Post Office initiated the development of air transport through contract airmail under private operation. Regulation and airways development were centered in the Department of Commerce. Technical improvements were encouraged by keen,

constructive performance and competition. Destructive rate competition was avoided.

Simultaneously technological development was encouraged through healthy rivalry between the armed services—a great force for progress. Inter-company competition has continued in war, though air craft manufacturers have shared their experience freely through their War Production Councils. They have cooperated in this crisis as effectively as they once competed in normal times.

The benefits of competition were also shared between the armed services and the air transport operators to the overall advancement of both. The fact that American aviation today stands supreme is due largely to the soundness of the fundamental policies evolved by the Morrow Board.

Men have long realized the vital importance to peace and posperity of free communication by land, but it was not until 1889 that the decisive character of over water communication became apparent. Then, Captain A. T. Mahan, in his classic treatise, "The Influence of Sea Power Upon History", proved conclusively that since the dawn of marine transport victory in war and prosperity in peace have rested with the nation which exercised control of communication by sea.

During the nineteenth century, the world enjoyed unexampled prosperity coupled with spiritual and material progress never before experienced. The combined British and American Sea Power swept piracy from the high seas and guaranteed the right of innocent passage to all who proceeded on their lawful occasions. With this power in the hands of a free people, the play of natural competitive forces accelerated the development of the arts and sciences.

In the twentieth century, this freedom of the seas has been challenged twice in the lifetime of the pioneers of the aircraft industry. In World War I, the Germans challenged with the submarine. The Japanese at first found it expedient to ally themselves with us to obtain German and other Pacific bases. Then, when the Germans tried again with the submarine, (their air force being military), the Japanese challenged with Naval air power. Thus, twice in the first half of this century, the beneficent sea power of free people has been challenged by autocratic powers seeking to dominate and enslave.

We have met this latest challenge by a rapid expansion of land, sea and air power. Today, our air power is supreme: The combined Military and Naval Air Forces of the United States now constitute the world's largest air force. Our aircraft manufacturing establishment is recognized as "the World's No. 1 industrial giant". As to air transport, our private domestic and international systems, already the world's largest and best before the war, have expanded by leaps and bounds.

At strategic points along the airlines of the world, we have built a powerful network of air bases. They are as vital to air power as are Naval bases to sea power. With these stepping stones, the Army and Navy Air Transport Commands have rushed men and materials to distant points in support of far-flung operations. Key men, on the spot, and face to face, have made decisions that insured success in complex operations which would otherwise have failed. The delivery of critical materials at the right place at the right time produced results that would otherwise have been denied. We simply could not have fought this war successfully without air transport.

We have extended air lanes in all directions. Though we look at these now as outward flowing streams, we must not forget that they are channels leading to the very heart of the country. Mahan, discussing the decisive influence of sea power upon our Civil War, and referring to the tightening of the Northern Blockade, said, "The stream that carried the wealth and supported the trade of the Southern states turned against them and admitted their enemies to their hearts."

This sea power comprised five basic elements: the Merchant Marine, strategic bases, the Navy, the shipbuilding industry, and a seafaring tradition. The cost of the Navy was accepted as a proper charge against the cost of water transport—yes, even as an investment in world prosperity.

Similarly, we see air power comprising the same elements—an expanding commercial air transport, strategic air bases, Military and Naval Air Forces, a sound

aircraft manufacturing industry, and an airminded public.

The precise influence upon history of air power is now in the process of determination but air power's influence upon land and sea communications has been made abundantly clear. Fundamentally the isolation once enjoyed behind land or sea frontiers is forever gone.

The Current Situation

The aircraft manufacturing industry operates today on a high plateau, having passed successively through three crises. The first crisis involved a shortage of machine tools, the second a shortage of materials and the third, a shortage of man-power. Within the latter there is an element of grave danger. Competent management and competent engineering are items whose importance cannot be overstressed. We have brought in management of proven competence from other industries through licensing and subcontracting. We have trained new production management from our own ranks. We have cooperated through the War Production Councils to increase the efficiency of our own management.

But the ability, eveo the willingness to take responsibility for management is a rare and precious quality. In a highly specialized engineering art like aviation, eveo men of real aptitude or competence, must acquire experience before they are useful. Even then a special quality is necessary for men who must conceive and create new art.

Ours is the responsibility to provide combat crews with aircraft of advanced design. We must take care that no adversary surprises us with some secret weapon. A technological advantage once lost is not likely to be recovered.

Aviation is a young industry. Most of its personnel is young. Thus, we are certain that the public interest requires the maintenance of the integrity of management and engineering in the aircraft industry. Removal of young engineers from private industry or interruption of a steady flow of them into it is fraught with grave dangers. A design staff once lost is not likely to be restored.

Turning now to production schedules, it is apparent that the very magnitude of the expansion of the aircraft industry makes it especially vulnerable to changes and cutbacks. Since renegotiation of contracts precludes the accumulation of reserves adequate to any contract termination that is not orderly and swift, the Government must accept its responsibilities in termination for all costs, including separation wages, lest important elements of the industry fail to survive. Until the completion of the cycle "war profits" are wholly illusory.

Our situatioo differs markedly from that of the automobile industry. Every day that passes, more automobiles wear oot and the demand for new cars increases. Similarly, every day that passes, automobile companies contribute to the surplus of aircraft and aircraft parts. At termination, automotive companies can reconvert, while aircraft companies must cut back to whatever remains.

While the airplane and automobile

both date from the beginning of this century, and while 40 odd years later the automotive and aircraft industries are collaborating in the production of aircraft industry designs for the war effort the two industries are fundamentally different. The automobile has had wide private use. The airplane on the other hand has been used principally in public service. The industry is almost wholly dependent upon government policy.

The problem of surplus war products is thus of peculiar concern to aircraft manufacturers. We note with satisfaction the steps being taken to provide necessary legislation to permit terminating contracts speedily and disposing of war surpluses in an orderly manner. We are impressed with the magnitude of this task and the need for courageous administration and control.

The factor of obsolescene is vitally important in aviation. Equipment is frequently made obsolete by technical improvement long before it has worn out in use. This factor should be given full consideration in controlling production. The flow of material must not run too far ahead of requirements, lest the latest service changes and improvements be not incorporated in combat aircraft.

Thus, the conduct of the war and plans for the future combine to dictate the first step in surplus control. To the fullest extent consistent with meeting every need of the armed services, the tightest rein should be held on current production to avoid unnecessary accumulation of inventories in the hands of suppliers and of finished products and spares in reserve.

Surplus aircraft material should not be viewed as excess inventory to be liquidated like commercial products, but rather in the nature of a reserve. It is public property. It should be administered with broad regard for the public interest. The public interest demands the maintenance of a reasonable level of employment. Dumping surpluses could so unbalance the aircraft industry and the whole national economy that the cost of unemployment compensation, or relief could quickly exceed any recovery through sale of surplus. War surplus must be considered in the light of other goods expended in the war effort. Good business judgment demands "no dumping."

Surplus aircraft will fall into two categories: those restricted to war purposes and those capable of conversion to commercial uses. The most modern surplus military aircraft should be stored in reserve. This will help employ available excess facilities. Convertible types should be used to promote air transport and private flying.

The rapid rate of obsolescence of aircraft makes timing the key to a sound disposal policy. The sooner surplus planes are made available for commercial purposes the more completely will desirable objectives be achieved. The immediate use commercially of surplus equipment before new improved models are generally available will aid in creating demand for improved equipment.

The vital principle here is that surplus aircraft must not be permitted to destroy the aircraft manufacturing industry. On the contrary they must be so utilized as to nourish it. The public interest requires that the aircraft manufacturing industry operate at the rate necessary to promote the creation of new designs and to facilitate rapid expansion in emergency. This must be accomplished through a continuing, orderly program of competitive procurement for the Army and Navy Air Forces as well as expanding private purchases for domestic and foreign transport. The whole should be supported by direct expenditures with the industry for research and experimental development.

In the matter of government-owned facilities, we are gratified by the steps being taken. Here, too, the controlling principle is the public interest. It must always be kept in mind that until the industry can develop a private market, the government is directly or indirectly its chief customer. It is axiomatic that no seller can compete successfully with his customer and that the private aircraft industry could not survive Government competition.

The record to date clearly shows the wisdom of having depended entirely upon private industry for aircraft production. Industry has met every requirement as to quantity and quality. The stimulus of private competition has produced great benefits. Technology has advanced. Costs have been dramatically reduced. The

whole management of aircraft production in this war under the principles enunciated in the Morrow report has been so successful as to clearly indicate the wisdom of continuing these policies. In fact, the whole relationship of government and industry in the aircraft program sets a sound pattern for other lines for the future

An Estimate of the Future

When the time comes for major cutbacks, the aircraft industry will face problems at least as difficult, if not more difficult, than those incident to expansion There has been no opportunity to develop other new products. It would seem that the "Minute Men" of this war, who have served the nation best technically and production-wise should survive. Today, aircraft production represents a substantial proportion of the national economy, and every opportunity should be afforded the industry to maintain itself

Continued manufacture of unneeded war goods would serve no useful purpose. We would simply be borrowing from future demand. This emphasizes the point made in the reports of the Vinson and Truman committees, that government departments should begin planning now for long-term needs Military and naval plans could approximate future requirements for several reasonable assumptions, and knowledge of these would assist private companies in their planning

We also believe that the key lies in the field of air transport. Our domestic airlines are carrying a heavy war load with greatly reduced equipment. It seems unrealistic that at a time when other war activities have greatly expanded their plants, the air lines have been contracted. It would seem in the public interest to step up their operations to a maximum, thus relieving the over-burdened surface transport and speeding the conduct of war business.

International Expansion Needed

The vital importance of international commercial air transport emphasizes the need for its expansion This should be taken in hand now as an immediate contribution to the war effort and a wise provision for future needs Expansion of air mail offers a profitable method.

The successful creation of the Air Forces under the War and Navy Departments suggests the need for lodging responsibility for commercial Air Transport in an executive department This department, in collaboration with the State, War and Navy Departments, should operate under the American Air Power Policy and in support of it. The Office of Assistant Secretary for Air in the Department of Commerce should be reestablished

As in the case of the air forces the key to progress in commercial air transport is technological development. Competition is essential in order that economic factors may direct technical progress along sound lines A prerequisite to the progress of the war effort and to the future of American air transport is the continued development of transport aircraft.

Today, American transport planes em-

body technical developments which grew out of air line competition and competitive purchases by the Army and Navy from private manufacturers. These manufacturers reinvested their earnings in improved technology and low cost manufacturing, so that prior to the war, both American commercial and military aircraft dominated foreign markets because of low cost and superior performances.

It is a noteworthy fact that at a time when certain established American industries needed a protective tariff, the self-reliant young American aircraft industry, maintaining a high level of wages and salaries, was able to undersell all foreign competition even though some of this was subsidized.

Our experience leads us to certain conclusions as to the elementary economics of air power. Our people have long been persuaded that expenditures in preparation for war are an out-of-pocket expense, and a burden tending to depress the standards of living. A free people seldom understands that an investment in protection against war may prove far more economical in the long run. Beyond this, money intelligently invested in an air power, adequate to keep the land, air and sea lanes open to commerce, will pay dividends through increased trade and the creation of new wealth. This is the history of each new form of transport.

One example is our own domestic air transport. It has been able to establish itself in direct competition with highly developed forms of surface transport by selling faster travel at competitive rates. It has furnished fast mail at premium rates high enough to return to the Post Office Department, approximately two and one-half times the amounts paid it for transporting the mail. Thus, the Post Office has fostered a valuable public service with a profit to itself.

From the economic point of view, we could credit the air mail profit back against the cost of military and naval aircraft. We might also credit income from export sales. But a strict accounting isn't necessary to prove that providing for the common security is not necessarily a burden upon the people. Done through private industry, it can be an investment. The benefits of judicious purchases to further new technology are obvious. They create new opportunities for private investment, new enterprises and new employment. Expanded Air Transport offers jobs for trained aviation technicians discharged from the Air Forces.

Another example of the profound influence of new forms of transport is the rapid expansion of transcontinental railways after the Civil War. This expansion took place under strong support from the government, and while some evils attended it the overall result was the opening up of vast new resources. No evils have attended the development of American air transport to date. The possibilities of the future development can scarcely be estimated.

The public character of aviation imposes upon it a dual role. Commercial companies, to advance their private interests and stimulate technical progress, must compete in the realm of operations. At the same time, they must collaborate in the realm of policy to promote the public interest. If any law or interpretation precludes such collaboration, it should be revoked.

Summary

International, domestic and private *Air Transport* offer a source of new wealth and employment. Rapid development is dependent upon improved technology stemming from a strong competitive private *Manufacturing Industry*. A dominant military and naval *Air Force* supported by air bases is a pre-requisite of free communication by land, sea and air. Only an air-minded people can provide that controlling air power which, in the hands of free men, is the hope of lasting peace and prosperity.

Ours is the dominant air power. Ours, too, the responsibility for a sound policy, courageously administed. The American Air Power Policy derives directly from our own experience.

Flight Stability

(*Continued from page* 141)

types of airplanes will not be too difficult.

Solution of the Biquadratic and Conclusions Derived

Y. J. Lin and Herbert Weiss, both of MIT, have give us an excellent method for finding the roots of a whole family of stability biquadratics. Any biquadratic equation will contain four roots. In our case, the motion involved implies that for a successful airplane, we must have at least one pair of complex roots in order to satisfy the condition that the oscillatory motion be damped out. Various and numerous are the conclusions which can be drawn from a thorough analysis of the equations and their roots. For the purpose of the investigation of the automatic stability, the most important one is that stability in pitch can be regarded as an independent phenomenon, while stability in roll and yaw cannot be conveniently separated since one influences the other. The order of magnitude of the damping coefficient is for most successful airplanes largest for the pitch axis and smallest for the yaw axis. This fact, coupled with the previous conclusion of inseparability of roll and yaw motions, leads us to anticipate that the difficulties to be encountered in the practical design of automatic pilots will be largest in treating the roll and yaw axis and least in the pitch axis. Experience bears this out.

Another important fact can be recognized which if forgotten will lead to unending complications. The natural return of the airplane to its original trajectory is, as we have seen of an oscillatory nature. Therefore, if the automatic pilot itself has oscillatory characteristics, great care has to be exercised to avoid resonance conditions. If this fact is not taken into account, instead of enhancing the natural stability by the use of the automatic pilot, we will destroy it. The safest way is to make the actions of the automatic pilot as nearly aperiodic as possible.

Before departing from the extremely abridged discussion of stability, we must mention that stability and maneuverability are incompatible with each other. Obviously the more stable the airplane, the harder it will be for it to leave its original trajectory. Consequently, if and when such an airplane leaves the trajectory, it will be very difficult for the ship to return to it. Experience proves that very stable airplanes under automatic or manual control are rather hard to manage especially in very disturbed air.

Automatic Pilot—Choice of Detectors

We have now became acquainted, superficially at least, with the general types of motion of the airplane. The problem which confronts us now is to find means to prevent the generation of those natural oscillatory motions. Our first task is to find some means which would react at the first instant when the airplane begins to depart from the chosen trajectory. In the field of instrumentation, we have a very good word for the impulse thus created. It is known as "signal," and this term will be used throughout this paper. There are many indicators which would be made to produce signals showing that the airplane has changed its original position in space or its original velocity. Thus far we have been successful in using only one general type of instrument for this purpose. No others possess the necessary characteristics of signal devices. What are these characteristics?

First, and foremost, we place accuracy. If the signal is inaccurate, the interpretation of the signal by the rest of the apparatus, the eventually generated control impulse will not be a true representation of conditions. Hence, such a signal will be worse than no signal at all, as it may prevent the airplane from returning, after a disturbance by natural stability to its original trajectory.

A second is the immediate recognition of departures or, as it is expressed in instrumentation, "lagless" response. The motions of a 300 mile per hour airplane are so quick that the signal which recognizes a disturbance even a fraction of a second after it originates, is useless and will in most cases disturb the airplane's natural return to the originally chosen path. The third and also very important feature of the signal is its previously mentioned aperiodicity. A signal which in itself is not "dead beat" and oscillates after the disturbance has been detected and corrected, will superimpose on the airplane's natural motions very undesirable and in some cases dangerous motions.

Among the many possible instruments which can be used as primary signals, only the direct indicators of the angles ψ, θ, ϕ have been found to possess the above mentioned characteristics.

These instruments are free gyroscopes with the axes placed in such a way that relative motions between the stationary gyro and the airplane produce the angles

ψ, θ, ϕ. While the choice of the gyro axes is theoretically immaterial for producing the relative angles, it has been found by practical experience that for detection of angular departures of θ, ϕ i.e., pitch and roll, a gyro with a vertical axis is most conveniently used. For the detection of yaw (angle ψ), a gyro with a horizontal axis produces very good practical results.

Due to phenomena which are peculiar to gyroscopes and which are common engineering knowledge, a direct transmission of those angles from the indicator to the control surfaces is not possible and servo motor systems have to be used. In some cases the signal by itself is of such small magnitude that it cannot conveniently operate the servo motor, and means of amplifying it have to be interposed. The description and analysis of each component would be so lengthy that a separate series of papers would have to be written. The constructional details of the mechanical, electrical, hydraulic and pneumatic devices which form part of many automatic systems have been designed with great ingenuity, and as one can visualize, offer an extremely fertile field to inventors since a great many combinations and variations are possible. The paper by House mentioned in the beginning of this article describes some of the oldest ones, while current trade magazine literature and the *Patent Gazette* both here and in England permit the study of all the intricate details which have to be worked out in order to build a satisfactory automatic pilot. For our purpose we must assume that satisfactory indicators, and transfer, amplifying and servo apparatus exist, and that we know them.

Simple Automatic Pilot

Now, let us take an airplane and see what happens under automatic flight. Assume, for simplicity's sake, that we want to fly in a straight line at an altitude of 2,000 feet. We will make the problem even simpler and concern ourselves at this moment only with the maintenance of the pitch axis parallel to the earth. At a certain instant the airplane is disturbed by an upward gust. The signal which we call α originates and the elevator assumes an angle β in respect to the pitch axis. Obviously, the airplane returns to its original trajectory. One could think, therefore, that the problem is completely solved but, as we shall see immediately, it is at this very moment, when the airplane starts returning, that serious difficulty arises. We have not emphasized, in fact, we have scarcely mentioned, that the airplane, being a rigid body, has inertia, and due to momentum will overshoot the original trajectory by a very considerable amount. At the cross-over point, the signal will reverse and will call for reversed control. The elevator's angle will change signs and the airplane will start a return trip toward our chosen position. The airplane will continue this see-saw motion with perhaps a small decrease in amplitude after each oscillation. What has this automatic pilot done to the airplane? Instead of employing the airplane's natural stability which would have brought the airplane down to its normal trajectory after say two or three oscillations, we deliberately introduced an oscillator and destroyed the natural stability. This fact is emphasized so that we may never forget the effects of inertia and that in any system which comprises a signal device, inertia and servo motors, means have to be provided to establish a proper relation between the signal angle and the control surface angle.

Mechanisms which modify the straight proportional relation between the control surface angle and the angle generated by the signal in such a way as to recognize the effects of inertia, are called "follow-ups."

Disturbances

An airplane gets disturbed by a force. This produces an acceleration; acceleration produces changes in velocity; velocity will produce changes in position or departure from our originally chosen trajectory. If we call α as the angle positioning the airplane about any one of the three axes, (ϕ, ψ, θ); α_0 the angle at the instant of departure; if β is the control surface angle of which the trim value is β_0 again taken for any control, then the following general relation, valid for each axis, can be written:

$$(\beta - \beta_0) = k_1(\alpha - \alpha_0) + k_2\frac{d\alpha}{dt} + k_3\frac{d^2\alpha}{dt^2}$$

in which k_1, k_2, k_3 are constant.

Follow-Up Operation

Let us go back now to the first experiment in which straight proportionality between the signal angle and the control surface angle was assumed, and substitute for this relation a tie-up as shown by the above more complicated equation. At the instant of the signal generation, β will be large because $\frac{d^2\alpha}{dt^2}$ is large. An instant later β will be somewhat larger since $\frac{d^2\alpha}{dt^2}$, while diminishing, produced a velocity $\frac{d\alpha}{dt}$ and to this sum we have to add the now generated angle α. We are still outside our trajectory, but due to the powerful angle β created an instant ago, we are beginning to return to our chosen path. What is now happening to $\frac{d\alpha}{dt}$?

It has become negative, thereby substantially decreasing the angle β. By the judicious choice of constants, we can arrange it in such a way that the angle β will reverse. We can see that by introducing the velocity and acceleration component, we have found a means of stabilizing the system because a very large control angle is created at the beginning of the disturbance which diminishes rapidly and even reverses as the airplane "coasts" into its original trajectory. k_1, k_2, k_3 are constants and for the time being of unknown value.

Obviously, if we study the stability derivatives and the roots of the biquadratic, we will soon find that a close relation exists between the constants of the automatic pilot and the stability derivatives, and the damping coefficient of the airplane. A very fine interpretation of this

relation will be found in the paper by Meredith and Smith, published in the Journal of the Royal Aeronautical Society about 1937. Unfortunately, the space limitation prevents us for the time being from following their analysis, but its study is highly recommended as it shows the close kinship between the natural and automatic stability.

It is extremely important at the start of an automatic pilot project to know where the general range of stability derivatives to which the pilot is to be adjusted, will lie.

Otherwise, it may easily happen that a perfectly well-conceived automatic pilot will not fit a group of airplanes because the range of adjustment of the constants k_1, k_2, k_3, will be completely out of range with that of the airplane. Naturally after we have matched the automatic pilot as near as possible to the type of airplane by means of theoretical analysis, we still have to fly the prototype and find experimentally whether the choice of our constants was correct. Experience has shown that if the matching is performed theoretically first, the number of experimental flying hours will be reduced to a minimum and the results obtained superior to those where purely experimental values are obtained for the setting of the nine constants.

Motions of the C. G.

Up to now we have discussed only motions of the airplane about its center of gravity. We neglected to mention the motions of the center of gravity itself. Gyroscopes recognize angles only. While theoretically the stabilization about the center of gravity would be sufficient to return the airplane always to the same trajectory we must realize that the whole medium is moved by atmospheric disturbances and the airplane will move with it. If we want to stabilize so that the motions of the medium do not affect the position of the center of gravity in space we have to add another series of signals to our angles detectors. For example, if we want to stabilize the pitch axis in such a way as to insure a constant altitude above sea level or any other reference, we have to add to our "follow-up" equation the expression—

$$K_4 \int_{t_0}^{t} (H - H_0)\,dt$$

H is altitude. Similarly, we could add a geographical signal to be superimposed on to the yaw axis, thereby forcing the airplane to fly automatically toward a chosen geographical point. A great deal of variation is possible and the choice of supplementary signals offers a very fertile field for experimenters. Various specifications can be met and the choice of signals will depend on them and on the accuracy required further on the purely mechanical complications which may occur in performing such additions.

We have not touched on the subject of imposing our own will on to the automatic pilot, but it may be said briefly that any automatic pilot must have provisions by which the airman can perform all kinds of maneuvers such as spiral down, climb, turn, etc. In this era of "blind" landing, and "blind" take-offs, it

is desirable to have such attachments which would enable the automatic pilot to translate signals coming from landing beams into automatic impulses making the craft descend a predetermined landing path. It would take many hours to explain the versatility of the automatic pilot and the very ingenious mechanisms which have been developed for this purpose.

Conclusion

We have sketched the difficult path which led airplane designers toward the understanding of fundamentals of dynamic stability. An equally thorny road full of obstacles has been conquered by the instrument engineer who succeeded against such odds as space and weight limitations, lack of power, etc., to produce a very creditable substitute for the human pilot. In many instances the automatic pilot is much superior to the airman and especially now when distances to be flown are great and flights have to be executed at 30 000 ft. and above. The automatic pilot never tires. In many instances the airplane engineering field and the instrument engineering fraternity have worked independently on the problem which concerns both branches directly. Pooling the knowledge of dynamic stability with the knowledge of instrument design for the general betterment of aeronautics is essential, and if this paper has acquainted airplane engineers with the instrument problem and vice versa, if it has shown the great wisdom in undertaking a mathematical analysis of the problems involved, it has accomplished its purpose.

Rivet Machine

(*Continued from page* 153)

different rivet diameters. The narrowest slots are at the upper end next to the hopper and each succeeding slot increases in size toward the lower end where rivets too large to enter the slots will continue to the end of the trough and enter a receiving tray.

Baffle plate—A plate extends down each side of the trough across the ends of the comb teeth and is positioned just high enough above the top surface of the teeth to permit the head of a rivet which is swinging in a slot to slide under and enter the receiving bin but not enough for the diameter of the rivet head to pass through. Thus, the rivets which are in slots slide out freely, since only the flat *thickness* of the head has to clear, but those still rolling on the surface of the comb plates are barred by the diameter of their heads. Small vertical pins are staggered across the area of the comb plates to reverse the roll of the rivets as they pass, and short extension fins are provided on the sides of each comb plate to further interrupt the downward travel of the rivets and thus aid in the sorting operation.

The 50,000-rivet-per-hour capacity of this machine is equivalent to from 8 to 12 lb. of rivets—meaning a decided saving when operating every working day of the year.

Fly Yourself

(*Continued from page* 184)

out that it has not proved possible to use regular automobile credit forms, customer rental lease agreements, or courtesy cards; the problems involved are too different. About the only connection now appearing possible between fly yourself and drive-yourself services is that the latter's downtown offices might be used as selling agents.

Even if money is available to buy and insure enough planes, and credit can be established for a sufficient number of customers, there are still additional problems to be solved.

The most important one is this: It is practically impossible to make a profit on Fly-Ur-Self operations alone. They must be tied in with other activities. In fact, it is the writer's opinion that the Fly-Ur-Self set up must be linked with four other operations: Aircraft sales, overhaul and maintenance service, sales of accessories and parts, and charter work. Aircraft sales include, of course, both new and used equipment in which the rental aircraft themselves are always on the market. Naturally, a Fly-Ur-Self service would provide some work for maintenance personnel and equipment, but both could be kept going more nearly to capacity by taking in outside work.

Whipping the foregoing problems still doesn't guarantee opening the pearly gates of profit, for a single-handed Fly-Ur-Self operation must of necessity remain of limited scope. The obvious answer would be to make direct-contract tie-ups or working agreements with others in the same field. This, in turn, means finding the right men with whom to do business.

It Takes Time and Money

This is no insurmountable problem, for such men are available throughout the country in sufficient numbers; it's simply a time and money-consuming job to find them. Such men must be operators possessing three qualifications: Integrity, ability, and (if this can be called a personal qualification) sound financial standing, with the three running in that order of importance.

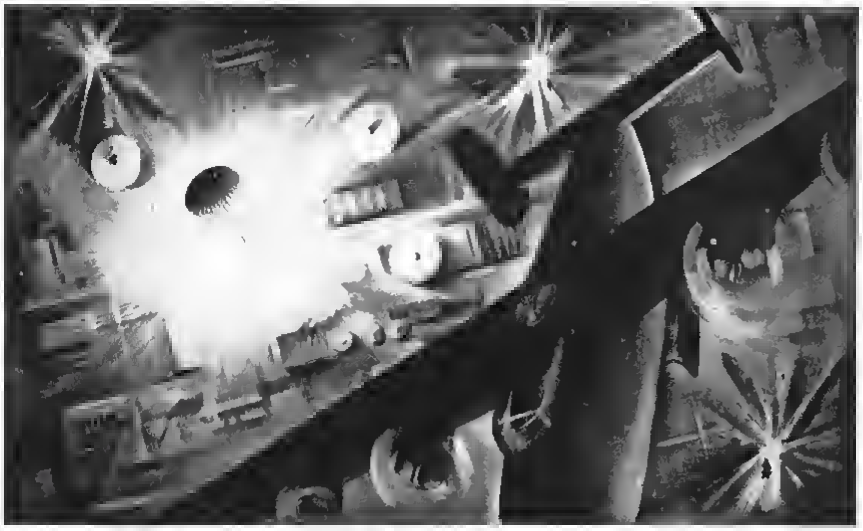
Making connections with other operators to form a network of Fly-Ur-Self bases naturally brings up two questions: First, how many would it take?, and, second, how much would it cost each of the operators?

It is my belief that the United States could be well covered with 100 bases, a number considered sufficient so that the oft-talked of rent-it-here-leave-it-there service could be offered. If such a network were to be a cooperative venture, it is believed these 100 operators would have to invest at least $10,000 000, or an average of $100,000 each, in addition to setting up uniform accounting, maintenance, and other service facilities. The phrase "at least," as applied to the outlay of money is used advisedly, for it is patent that different localities will require different investments, just as they will produce different returns. The metropolitan New York City area, for instance, would require an investment of at least $500,000 if the job were to be done properly.

Suppose, it may well be asked, it appears desirable or looks like a good bet to start from scratch and set up a nation-wide service on a corporation basis—then how much money will it take? Again, on the basis of experience (plus considerable "3 to 5 A.M. planning") it would seem the $10,000 000 figure would be the bare minimum.

This would assume at least $5,000,000 going for equipment consisting of 1,000 planes of, perhaps, no more than two types—two-and four-place. If these planes were all ordered from one manufacturer it is felt possible the craft could be bought within the $5,000,000 budget.

To date, however, few manufacturers have made serious inquiries about the types of equipment that might be desirable, a situation which is understandable in view of the fact they are all thoroughly occupied on warplane production. But the time is coming when they will be seeking such outlets for their production lines, because there is every chance that a national Fly-Ur-Self service—cooperative or corporate—can become a vital factor in the personal plane market built up in the coming peace.



Planting A Victory Garden . . . *by Candle-Light*

A STRANGE and fearful candle-light brightens the streets of this Axis town tonight. A moment ago, it lay safely hidden under cover of a moonless blackout.

But, it was on tonight's schedule of time-table bombing and as "Libs" and "Forts" come in for the "kill", this night-time enemy target is brought into sharp relief by the brilliance of McAleer military pyrotechnics.

In that revealing glare the refinery's oil tanks stand out like giant mushrooms in a meadow—but not for long. Caught in the cross-hairs of a bombsight, they disappear in thick black smoke. A power station crumbles under a well planted "stick". Factories and warehouses belch flame that reaches fiery fingers into the heavens.

It's Victory Garden planting of a different sort. Seeds of retribution from which will come fruits of Victory!

Making military pyrotechnics is but one of the important war production tasks assigned to McAleer. There are other For-Victory products extending into the fields of military aeronautics and hydraulics as well.

ON THE HOME FRONT we fight the war too . . . furnishing *quality-controlled* finishing materials and methods which contribute more to the war effort. If increased finishing efficiency on metal, plastic or wood can help YOUR war effort . . . our advisory facilities are at your service.

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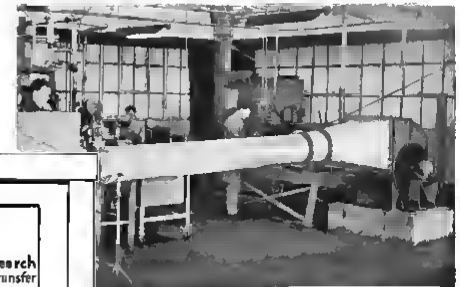
MANUFACTURING CO.

Manufacturers of Quality-Controlled Finishing Materials, Military Aircraft Sub-assemblies and Pyrotechnics

ROCHESTER, MICHIGAN

This is the way to improved Oil Cooling



HERE'S THE HOT TUNNEL where oil cooler designs are tested under conditions similar to flight. It creates air flow equal to speeds met in flying . . . circulates hot oil through the cooler . . . weighs the oil flow to determine cooling efficiency. By such tests, AiResearch has been able to perfect oil coolers that are *lighter-weight* yet provide greater cooling efficiency per square foot.

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. . . AND THE CYCLING EQUIPMENT for life-testing. Each oil cooler design must stand up under 60 lbs. psi steam pressure applied 50,000 times!

It's here that AiResearch proved the ruggedness of their elliptical oil cooler design—the first ever built to withstand such terrific pressure.

IMPROVING HEAT TRANSFER EQUIPMENT is a specialized project at AiResearch. Continued research here is bringing forth many new developments in heating and intercooling as well as oil cooling. Information is available now to you who are building today's—and planning tomorrow's—aircraft.

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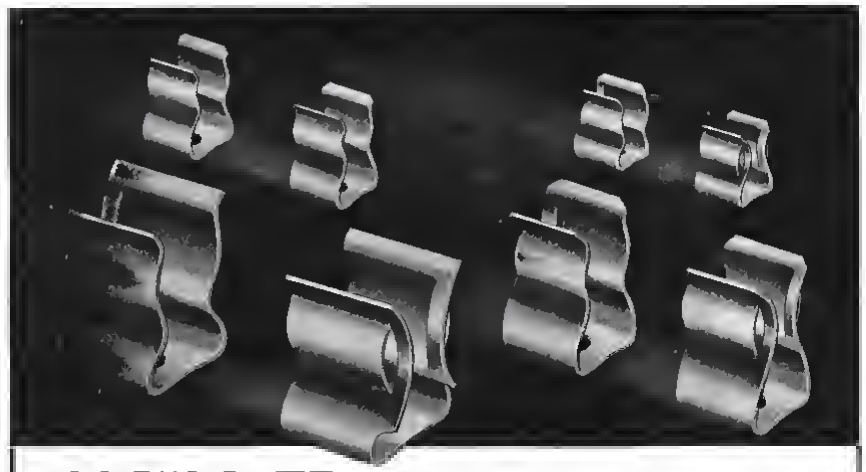

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FUSE CLIPS

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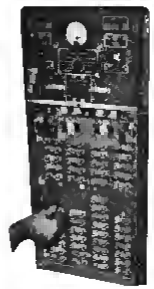

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Wherever fuse clips are used—in aircraft, communications, industry, electronics, electrical products—from most delicate meters to high voltage services, Littelfuse solves the problems with *new improvements*. By exclusive Littelfuse design and forming, the best possible contact is obtained, with maximum electrical conduction. Less heat is produced. Temperatures in panel boards and switches are reduced. Loss of clip temper is prevented. Spring qualities are retained much longer. Contact between fuse cap and clip is made over *largest possible area* with extra tight grip.

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A LIGHTNING blur as the slim, grey hull streaks in—a white trail of foam on an azure sea—a blinding flash—a thunderous roar—and it's "hot-toms up" to another enemy ship.

Swift, powerful, deadly, despite their midget size, the mosquito fleet has struck terror to enemy shipping in every theatre of operation.

And the success of these small craft is due largely to the Sterling engines in their holds—engines so powerful that they have aptly been called "masterpieces of precision design."

Compactness and precision are characteristic, too, of the Foote Bros. gears that aid these engines in delivering their power. For today, these high precision gears are being turned out on a production basis made possible by new manufacturing techniques—new production know hows.

When the war is won, such high precision Foote Bros. gears will offer American manufacturers new efficiencies in power transmission for machines of peace.

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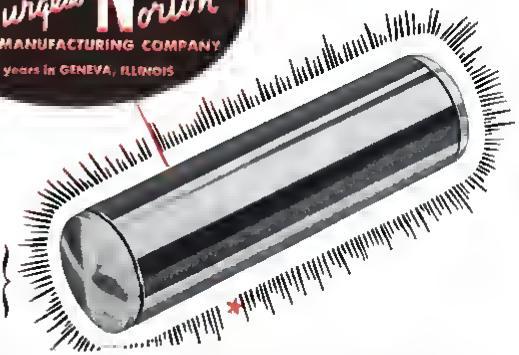
Illustration:

This tank track part is fabricated by brazing together precision machined alloy tubing and forgings.

Hydrogen Copper Brazed cooled, reheated and quenched by Burgess-Norton in one continuous furnace operation.

of the completeness of Burgess-Norton's facilities for post-war production of precision parts which will be available to manufacturers when Victory Day draws nearer.

Burgess Norton
MANUFACTURING COMPANY
40 years in GENEVA, ILLINOIS



Precision Finishing as performed by Burgess-Norton is exemplified by the production of piston pins with finishes as fine as 2 micro inches.

A Part is Never Made Right unless it is Satisfactory to Our Customers

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MANY an American fighter pilot has cheated death and the Jap on his tail because of a single word of warning shooted into a radio from another American fighter above him.

That word could never have been transmitted were it not for the aircraft radio! But neither could it have been *heard* above the interference of the high tension currents in the ignition system *if the ignition cables had not been shielded.*

So work that began nearly a generation ago in research laboratories like those of Titeflex made possible radio-connected fighter tactics, bomber strategy, and the far-flung operations of the Air Transport Command today.

But the triumphs of the last twenty years are of interest to Titeflex today chiefly in that they prepare the way for the research for the next generation of aircraft.

The problems of intense heat, extreme cold, incessant vibration, and tremendous wind resistance against which Titeflex must maintain continuous electrical shielding for currents of 10,000 volts — all these have been solved. But they are merely the stepping stones to the solutions of postwar aviation.

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"Jet propulsion opens a new chapter in aviation"

says Laurence D. Bell, President of the Bell Aircraft Corporation

"THE NEW JET-PROPELLED PLANES *open what promises to be a completely new chapter in the story of man's victory over the air.*

"These planes are flying constantly and their pilots report smoothness, simplicity, and evenness of power.

"And this is only the beginning. Many engineers believe that Jet Propulsion planes will have speed, altitude, and other performance characteristics beyond anything previously thought possible.

"Maybe. But Jet Propulsion is still so new that it is against the best interests of aviation to make startling claims for a radical principle of flying whose developmental life still lies in the future.

"The really significant thing is that American engineers have finally developed this new principle of propulsion in an American-designed-and-built plane. In aviation the difficult job is always proving a principle. After that, sound engineering will guarantee that theory can be effectively translated into fact."

AND EVEN *THEN*, MR. BELL — even after the perfect postwar plane is tried and proved — the job is only half done, for then the plane must be *sold.*

And no selling plans are complete that fail to include the "test pilot market" — the market of people who (in business or in private flying) are always first to accept progress.

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TIME here gives them wider circulation
in the name of

AVIATION'S SILENT PARTNERS — TIME — THE READERS OF TIME

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R-301 is so tough it is used as armor on the new fighting planes. Pound for pound it surpasses former armor plating metals.

R-301, THE NEW REYNOLDS-DEVELOPED ALUMINUM ALLOY, combines high strength and resiliency for the first time. Elasticity and thermal conductivity, so vitally important in absorbing kinetic energy without fracture, are inherent properties of this latest Reynolds triumph of metallurgy.

Tests with armor-piercing shells have proven that *pound for pound* R-301 surpasses former armor metals . . . and that's why new fighting planes are protected with this latest Reynolds aluminum alloy.

R-301 is the first high-strength aluminum alloy that has a hard core as well as a tough surface cladding... with a corrosion resistance almost as good as 99.5% aluminum! The cladding is more homogeneous in relation to the core, and this adds still other important advantages—higher bearing, shear, yield and fatigue strengths.

R-301 is more workable than previous high-strength aluminum alloys. From the initial die stampings right down to the final fabrication, R-301 speeds production and cuts spoilage.

R-301 is being produced in three tempers, suitable for a wide range of structural and industrial applications. Write for full information. Reynolds Metals Co., Aluminum and Parts Div., Louisville, Ky.

R-301 being tested for hardness. It has a tough cladding as well as a strong core . . . and a corrosion resistance almost as good as 99.5% aluminum.

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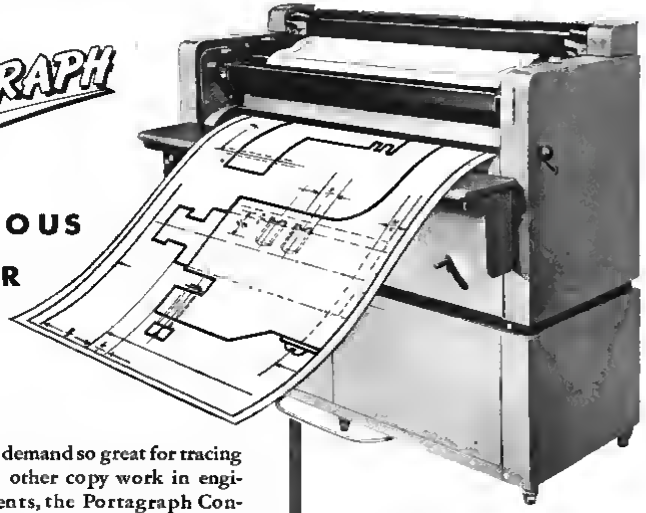

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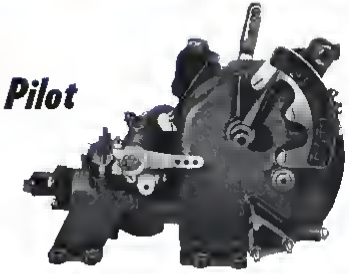

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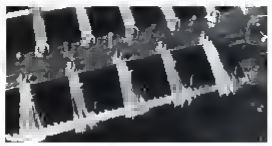

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(Above) The record-breaking TWA-Lockheed Constellation on a test hop.
(Below) A Constellation in military dress, takes aboard a load of soldiers. *(TWA Airlines photos)*

Guinea pigs for grease monkeys

Real production line P-38's and Venturas are guinea pigs for air corps mechanics at Lockheed's factory service schools. These few planes will never see combat like other Lockheeds—but because of *them* others will fly oftener and longer.

Lockheed Trains Specialists

In the Lockheed-operated schools Army and Navy ground crews become specialists—expert in their knowledge of the Army's fighting P-38 or the Navy's tough PV-1 Ventura. Under the supervision of company instructors, they learn the mechanics of maintenance, repair and overhaul, as well as special tricks for keeping Lockheeds in fighting trim.

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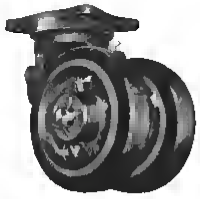

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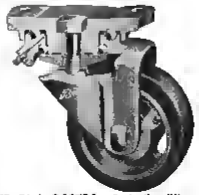
BOND V-GROOVED WHEEL CASTER. This new Bond Caster is built especially for use on track line assembly. The V-grooved wheels travel on angle iron tracks. Time and floor space are saved, obstruction to material flow are eliminated, effects of floor vibration are reduced. Double ball race construction. Pressure lubricated throughout.



BOND 36-A CASTER. Serically different in design. Combines easy swiveling with long service due to special arrangement of its ball races and use of durable bond carter metal. Pressure lubricated throughout.

BOND 40-A CASTER. The light weight caster for heavy duty service. Sturdy all steel construction reducer caster breakage, cracking or excessive wear even under peak loads. Swivels with frictionless race. Pressure lubricated throughout. Wheel sizes from 4" to 12" diameter. Load capacities from 425 to 4500 lbs.

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Address Dept. A-24

THE special high-alloy steels take more knowing than ordinary materials, that's sure. But they also *give* you more—so much more that their uses have taken one of the steepest upward climbs of any class of materials in recent years.

Electric furnace steels are on the march. Our principal special steel products—corrosion and heat-resisting alloys, tool and die steels, electrical, valve and nitriding steels—have been among those in keenest demand for war use. They're also products which offer you the greatest future promise.

As pioneers and originators in these fields, we have the data your engineers and designers need, and the working information for your shopmen to handle special steels well and speedily. Let us help you.

Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: BRACKENRIDGE, PENNA.

WkD A-9332

PERHAPS the 1000-passenger stratoliner complete with solariums, badminton courts and swimming pool, so glibly pictured by the unbridled illustrators of the Sunday supplements, will some day sweep through a startled sky.

But we are inclined to believe that the time is still far distant.

In the meantime, our engineering and research staffs are keeping their minds fixed on the pressing problems of the present—and the *immediate* future.

Working shoulder to shoulder with airframe designers and builders, and with engine and parts makers whose tremendous task today is to make America's planes the finest that fly, we are developing new and continually better products for aircraft use.—*Aircraft quality wire of every type*—stitching wire for the faster, cheaper assembly of parts—hinge-pin wire, strut and tie wire, lock wire, cotter-pin wire—bright finished, tinned or galvanized wire in carbon, alloy and corrosion resisting steels; TIGER BRAND *Control and Structural Cables* that assure perfect functioning of controls; *Springs* of all types and sizes—extension, compression and torsion springs—plane part springs, springs for precision instruments, new and special springs for the plane's fighting armament; *Cold Rolled Strip Steel* to add strength to airframe and accessory construction, *Cold Finished Bars* of aircraft quality steels, that make possible mass production of high precision parts.

Eminently practical, as nearly perfect as we can make them, these aircraft products have truly earned their wings. Their fine performance in planes that are making aviation history speaks well for our ability not only to take care of today's stiff requirements, but to meet whatever needs the unpredictable future may present.

AMERICAN STEEL & WIRE COMPANY

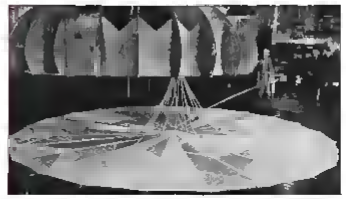
Cleveland, Chicago and New York

Columbia Steel Company, San Francisco: *Pacific Coast Distributors* — United States Steel Export Company, New York

UNITED STATES STEEL

The canopy is placed over frame and shock-loaded by hydraulic pressure that can reach 1,190 pounds. Pressure applied is recorded on gauges. This permits close range study of weaknesses in the fabric, seams or lines that may occur under abnormal pressures.

PIONEER PARACHUTE *leads again with the New Revolutionary* CANOPY TESTER



The canopy is spread on the floor. Each suspension line under 20 pounds of radial pressure permits close check on design, pattern, construction and dimensions of canopy.

The vent of canopy is being closely examined to ascertain any weakness that might occur in actual operation.

The new and exclusive Pioneer Parachute Company Canopy Tester guarantees the most positive canopy testing method ever achieved and for the first time permits minute and practical examination of the canopy at close range. With this device the important factors of strength and durability are tested. Achievements such as the Canopy Tester have a far reaching effect on parachute development. This ceaseless research results in continued parachute improvement and in Pioneer Parachute Company's leadership in the manufacture of fool-proof, foul-proof parachutes.

Keep on buying WAR BONDS and help speed VICTORY

CHENEY *Fabrics*

PIONEER PARACHUTE COMPANY, INC.

MANCHESTER, CONNECTICUT, U. S. A.

CABLE ADDRESS: PIPAR, TELEPHONE: Manchester 4157

Facts YOU SHOULD KNOW ABOUT RELAY SENSITIVITY

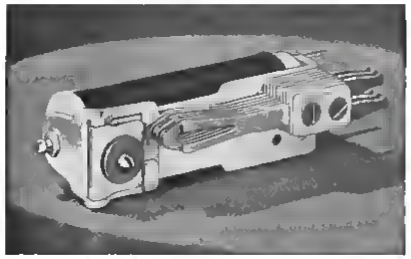
So YOU would like a *sensitive* relay for that remote control circuit!

Sensitivity is important for many relay applications. And if that is *all* you want, there's no problem. It's easy to build a relay that will "operate" on a small amount of power.

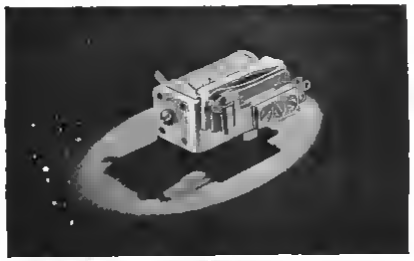
But sensitivity without contact reliability is useless. So what you *really* want is a relay that is not only sensitive, but also has the contact pressure needed for reliability under actual service conditions.

Sensitivity and contact reliability are opposing factors. To get a high measure of both qualities in one relay calls for an exacting balance between electrical, mechanical and magnetic design factors. We've been building such relays for years—to meet hundreds of requirements, from complex telephone switching circuits to simple control functions on aircraft and radios.

Next time you need a *sensitive* relay, let the Automatic Electric field engineer show you how to get sensitivity *plus* contact reliability. No matter what the nature of your problem, there is an Automatic Electric relay that will give you both.



The Automatic Electric Class B Relay shown here combines high sensitivity and contact reliability. It has a highly efficient magnetic circuit, long wearing mechanical structure, independent twin contacts, and capacity for any number of springs up to 26. Contact pressures average 20 grams per contact. Compare this with "sensitive" relays having contact pressures of less than five grams.



For high sensitivity and contact reliability in small space, your best bet is the Class S Relay shown here. Especially designed to meet the severe conditions of operation on fast modern aircraft, it is also recommended where space is at a premium. Because of the great demand for Class S Relays for vital war products, we urge that you avoid its use except where no other relay will serve.

Relays AND OTHER CONTROL DEVICES by AUTOMATIC ELECTRIC

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street • Chicago 7, Ill

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

TOOLS TO BUILD THE WORLD OF TOMORROW

.... born from the need of today

JOB-PROVEN FEATURES OF Thor "Armored-In-Plastic" ELECTRIC TOOLS

Born of a need to conserve critical aluminum, Thor "Armored-In-Plastic" portable electric drills today are smashing quotas on the jobs for which they were created!

Developed with features that provide light weight, easy handling, toughness and durability . . . these remarkable tools bring to vital industries unsurpassed production performance

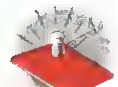
Thor "Armored-In-Plastic" portable electric tools already have a solid background of experience that will enable them to fashion—*more rapidly and more lastingly*—the emerging "World of Tomorrow."

Extra lightness of weight—Application of "Thorlin" plastic in gear case, field case and handle housings provides 14% lighter weight—without sacrifice of maximum power and other essential properties

Exceptionally high impact strength—Tests by approved laboratory methods show Thorlin plastic tool housings to have impact strength greater than aluminum... assuring high resistance to shock blows.

Remarkably low thermal conductivity—"Thorlin" is a non-conductive plastic that prevents heat developed by the motor from being transmitted to the hand of the operator—providing constant cool handling

Increased safety factors—"Thorlin" plastic housings are efficient as non-conductors affording extra safety against electrical shock.



Toughness and durability—Strength characteristics of "Thorlin" plastic as shown under approved testing methods, compare favorably with aluminum

(Tensile strength — 9 000 pounds per square inch; Flexural strength — 13 000 pounds per square inch; Compressive strength — 23 000 pounds per square inch.

AND... WHAT ABOUT "THE TOOLS OF TOMORROW?"

Thor has more new and revolutionary portable electric tools in its experimental laboratories today than at any time in its fifty years of paving the field with new developments. For a brief glimpse of the trend ask for your copy of Thor's remarkable new booklet "Tools to Build the World of Tomorrow—Born from the Need of Today."

Thor Portable Electric Tools

INDEPENDENT PNEUMATIC TOOL COMPANY

Branches in Principal Cities

You have doubtless seen this and other pictures of aerial cameras in newspapers, magazines and in many advertisements. But do you know who developed the aerial camera — and produces, by the thousands, these vital instruments of war and peace?

It is the company founded by Sherman M. Fairchild, who developed the prototype of the modern aerial camera during the last war.

From aerial reconnaissance photographs taken with Fairchild cameras at altitudes up to *seven miles*, our Army and Navy glean vital information about the enemy. They determine, accurately, the position and caliber of guns, the location of radio installations, the count of enemy troops, naval vessels, etc., the nature and depth of submerged offshore obstacles, and other data essential to successful combat. In addition, they speedily prepare from aerial photographs accurate maps necessary for offensive action on land, at sea and in the air.

For all of these purposes, Fairchild makes these extremely accurate, unique cameras. A few of them are illustrated at the right. They are the cameras used to make the aerial pictures you see everywhere . . . truly the *aristocrats* among precision cameras.

A few of the modern Fairchild cameras, developed in cooperation with U. S. Army Air Forces and the Bureau of Aeronautics of the U. S. Navy.

Fairchild CAMERA AND INSTRUMENT CORPORATION

88-06 Van Wyck Boulevard Jamaica 1, N. Y. • *New York Office* 175 Tenth Avenue, New York 18, N. Y.

THE STORY OF AERIAL PHOTOGRAPHY IS THE STORY OF FAIRCHILD CAMERAS

MAKES CONNECTIONS STRONG

Keeps Circuit Resistance Low!

Mechanically, and Electrically, HYDENT (indent type) Connectors lead the way. For they are formed from pure copper in One-Piece . . . without seams or joints. Thus the HYDENT connection is stronger, and surer, with no danger of added resistance from extra contact surfaces. And HYDENT one-piece design contributes compactness, too, making them preferred wherever space is limited and weight a factor. Be sure to have complete specifications on all HYDENT Connectors at your fingertips. The HYDENT catalog will gladly be sent on request.

Headquarters for CONNECTORS

Burndy

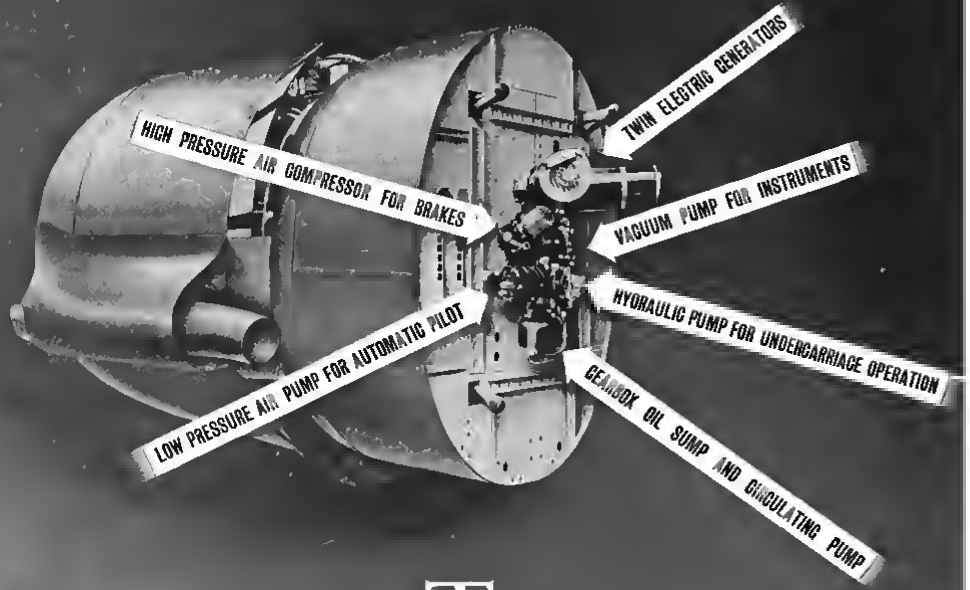
Burndy HYLUG Equivalents of New Aircraft Standards

AN639 and NAS39

AN639 NAS39 Dash No.	BURNDY Catalog No. (indent type)
1	YAV18-H6
2	YAV18-H
3	YAV14-H5
4	YAV14-H
5	YAV19
6	YAV19-T2
7	YAV6C-L
8	YAV6C-L2
9	YAV6C-L
10	YAV6C-L2
11	YAV4C-L
12	YAV4C-L2
13	YAV2C-L1
14	YAV2C-L
15	YAV1C-L1
16	YAV1C-L
17	YAV25-L1
18	YAV25-L
19	YAV26-L2
20	YAV26-L
21	YAV27-L
22	YAV27-L1
23	YAV28-L
24	YAV28-L12

BURNDY ENGINEERING CO., INC., 107 BRUCKNER BOULEVARD, NEW YORK 54, N. Y.

ACCESSIBLE ACCESSORIES



ROTOL UNIVERSAL GEARBOX

MOUNTED ON THE REAR SIDE OF BULKHEAD . . . THE GEARBOX IS NOT DISTURBED WHEN THE ENGINE IS REMOVED FOR MAINTENANCE

Fitted to all types of Hero Engines

ROTOL LIMITED, ENGLAND • *Canadian Representatives* BRITISH AEROPLANE ENGINES LIMITED · MONTREAL

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities

4 days out—4 days back—and the weather be damned!

1. **"Tired? I'll say I am!** You'd know if you'd ever flown a 200 mile per hour cargo plane as from the Orient for the Air Service Command." He was only 22 years old, this Liberator Express pilot. He'd just brought his ship in — the end of a round-trip run on the longest air freight haul in the world. From India, 14,000 miles away, to Patterson Field, outside Dayton, Ohio!

2. **Day in, day out,** the huge, long range Liberator Express transports roar down this Ohio runway and streak southward to Brazil's hump, then across to Africa and on to the navy bases of Jap-held Burma. The boys who fly this shuttle run — in all kinds of weather — call it the 8-day "Pony Express." — 4 days out, 4 days back.

3. **Each Liberator Express** carries many tons of high-priority cargo — aircraft parts and supplies urgently needed by American airmen based halfway around the world. Magnetos, fuel pumps, jungle kits, propellers, starters, aircraft engines, radios, and other vital accessories. "It's a rugged run," the pilots say. "But our combat flyers are doing a terrific job out there — and how they need the stuff we take 'em!"

4. **Dramatic as the India run is,** it's only one of the ways in which we're solving the stupendous problem of supply for United States air bases the world over. Every day, thousands of tons of supplies are loaded into freight cars and trucks at huge Air Service Command warehouses scattered over the U.S.A. The furious tempo of Allied aerial warfare calls for miracles of transportation, not only by air, but over highway, by rail, and on the sea.

CONSOLIDATED VULTEE

5. **Boxes and crates,** brought by truck and train, are lowered into the holds of waiting ships. Often part of the cargo consists of fighter planes which have been flown from factory to dock. Partly dismantled, they are lashed down on girder-like false decks for delivery overseas. Our constant and gigantic torrent of transoceanic shipping is truly a bridge of supply which is taking us closer and closer to Victory.

6. **The plane,** the train, the truck, and the ship must team up together to help rebuild the peacetime world, just as they are working together to win the war. In fact, transportation will be a vital key to postwar peace and prosperity.

But the plane will also have a second role to fulfill. For the long reach and overwhelming might of American air power can well become this freedom-loving nation's most effective force for ensuring a lasting peace.

Quick Facts for Air-Minded Readers

New role for the "Cat" — Although designed as a Navy patrol bomber, the Consolidated Vultee long range Catalina flying boat is also being used as a transport, flying natural rubber out of South America.

* * *

New war Bonds buy more bombers — In the 1943 fiscal year Consolidated Vultee has made savings of $25,000,000, which have been passed on to the government in voluntary cash refunds and price reductions and reserves for further refunds. This saving came about through new operating economies and efficient use of manpower which enabled the company to turn out *more* planes for *less* money.

* * *

North Atlantic Shuttle — It is reported that flights across the North Atlantic in both directions are now running more than 1,000 a week.

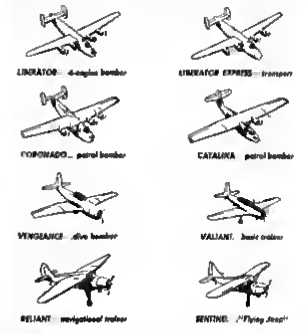
* * *

For Distinguished Service — Though operating with only about half their prewar equipment in '43, the airlines of America flew 37,639,000 ton miles of mail (*a gain of 78%*) ... 15,774,000 ton miles of express (*a gain of 54%*) ... 1,540,000,000 passenger miles (*a gain of 10%*).

Consolidated Vultee is the largest builder of airplanes in the world.

No spot on earth is more than 60 hours' flying time from your local airport

From "Flying Jeeps" to Leviathans of the air — *The planes shown below were all designed and developed by Consolidated Vultee. When peace comes, the company will be in a position to provide the postwar equivalent of such planes, from small, privately owned "air flivvers" to huge transoceanic cargo-and passenger planes.*



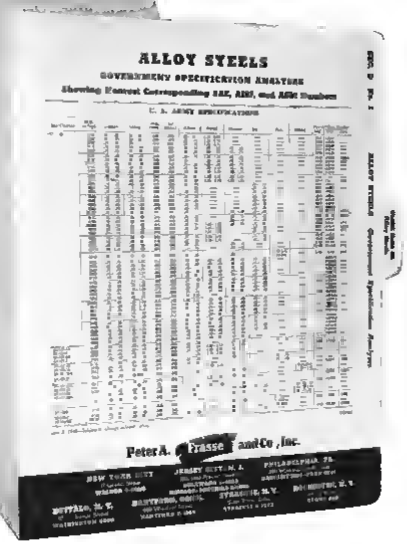
AIRCRAFT

San Diego, Calif. · Vultee Field, Calif. · Fairfield, Calif. · Tucson, Ariz. · Fort Worth, Texas · New Orleans, La. · Nashville, Tenn. · Louisville, Ky. · Wayne, Mich. · Dearborn, Mich. · Allentown, Pa. · Elizabeth City, N. C. · Miami, Fla.

Member Aircraft War Production Council

New GOVERNMENT "SPECS" FOR ALLOY STEELS

Revised Frasse Data Chart Now Available



INCORPORATING all recent corrections and additions this new Frasse Data Chart enables you to identify latest Government "specs" for alloy steels at a glance.

It shows the chemical analysis requirements for each Army, Navy, and Federal specification, together with its nearest commercial equivalent in SAE, AISI, and AMS numbers. Government "specs" for NE steels are included.

The chart is handy file size, printed on tough stock, and suitable for wall or desk use. If you're working to Government "specs", you'll find it invaluable. Just send in the coupon—a copy will be sent to you by return mail.

Frasse MECHANICAL AND AIRCRAFT STEELS

Peter A. Frasse & Co., Inc.
Grand Street at Sixth Ave.,
New York 13, N. Y.

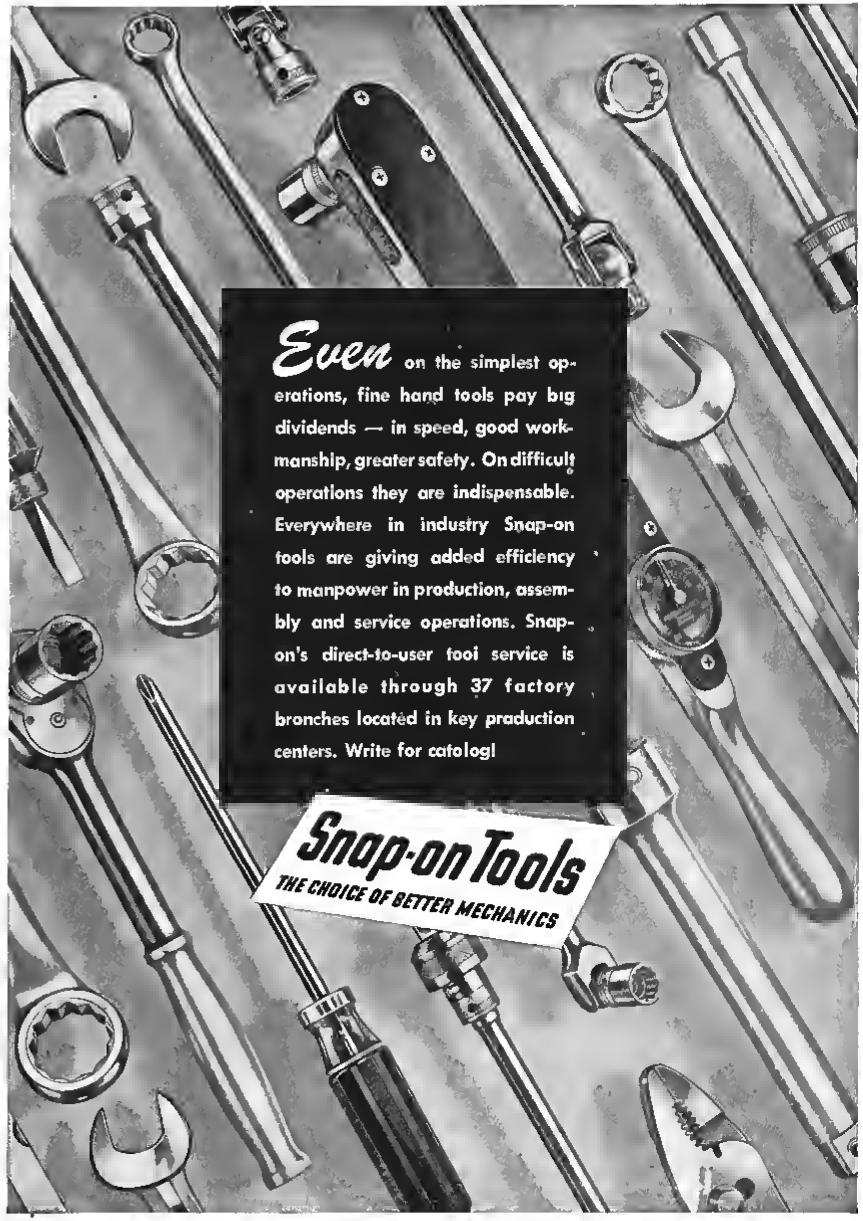
Please send me a copy of your latest Frasse Data Chart, Section D, No. 1, showing Government "specs" for alloy steels and corresponding commercial designations

NAME _____

FIRM _____ ADDRESS _____

16

SEAMLESS MECHANICAL AND AIRCRAFT TUBING • COLD FINISHED BARS • DRILL ROD • AIRCRAFT STEELS
STAINLESS STEELS AND TUBING • ALLOY STEELS • COLD ROLLED STRIP AND SHEETS • WELDED STEEL TUBING



SNAP-ON TOOLS CORPORATION, 8020-F 28th Avenue, Kenosha, Wisconsin

Aircraft Clevis Bolts

AND PINS ARE MADE BY LAMSON WITH 75 YEARS OF "KNOW HOW" BACK OF THEIR PRODUCTION . . .

When an American bomber or pursuit ship sets down "somewhere east of Suez", in the arctic wastes of Labrador, or Attu or Greenland, or in what was an English meadow—it's reasonably sure that in that ship there are Lamson Clevis Bolts and Pins. We've made so many that these very "special" parts of modern aircraft have become "standard" parts, and we're getting them out faster and faster as we become more expert in their production.

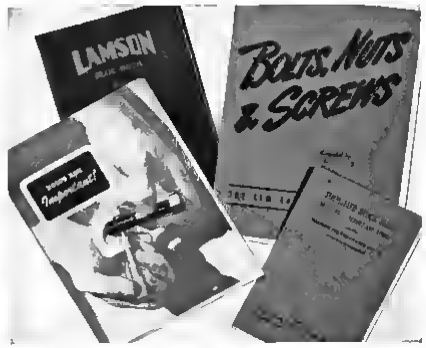
The latest "AN" specifications are used in making both Clevis Bolts and Pins, from the largest to the smallest sizes. And the care used in their manufacture is the same as that for aircraft engine bolts, or any other aircraft product that we make.

Of the many operations and inspections that are needed we can say just this—that nowhere is there more modern and complete manufacturing experience or more exacting laboratory control than we have here at Lamson & Sessions.

Inspections are made with the most modern equipment available, and our personnel is aware of the importance of their individual jobs. Some of their efficiency is traced back to the beginning of our Aircraft Products Division six years ago when we set up a special section in one plant to be devoted to this special service. When the war began, Lamson & Sessions was already knee-deep in production for Allied aircraft products.

Ask for a copy of the Lamson list of "AN" aircraft parts we manufacture.

THE LAMSON & SESSIONS COMPANY, General Offices, Cleveland, O.



"BOLTS, NUTS & SCREWS"—1944 REVISION. Cloth bound, Limited edition 180 pages of technical, practical information. Sent prepaid for *$1.00—cash or check must accompany your order*

"BOLTS ARE IMPORTANT!"—24 page booklet of currently useful information for buyers of headed and threaded products, and describing Lamson & Sessions specialty fastenings which have wide industrial applications *—now, and in the post-war period. Sent gratis.*

"THE LAMSON BLUE BOOK"—is our standard Catalog of standard products excepting our Aircraft products. *Sent gratis.*

"SIMPLIFIED STOCK LIST"—Of bolts, nuts and screws, conforming to latest revisions of the Office of Price Administration, and of great value in showing you on what range quantities of various standard products are kept in stock for deliveries, by your jobbers and in our own (and other bolt manufacturers') warehouse stocks *Sent gratis.*

HERE'S A COUPON FOR YOUR CONVENIENCE

THE LAMSON & SESSIONS COMPANY • 1971 West 85th Street • Cleveland 2, Ohio

Please send us ☐ Lamson Blue Book ☐ Bolts, Nuts & Screws ($1.00)
☐ Bolts are Important ☐ Simplified Stock Sizes

Name of Individual _____ Title or Kind of Work _____

Employed by (Name of Company) _____

Street Address _____

City and State _____

LAMSON & SESSIONS

"AN" BOLTS • • "AN" NUTS • • "AN" COTTERS • • "AN" SPECIALS

Aircraft Division

CORSAIR FG-1 *Built by Goodyear for the Navy*

This famous streamlined fighter has been battle-tested wherever American flyers are engaged. It has the qualities needed for a tough assignment any time — anywhere.

Fenn Aircraft

BUILT PARTS FOR FAMOUS PLANES

Fenn Plants produce special parts and assemblies for Goodyear and other aircraft manufacturers to rigid specifications. The photograph shows a bulkhead fitting, machined from a solid aluminum forging.

FENN FOR SPECIAL MACHINERY

Today Fenn Plants are wholly engaged in war production, but when peace comes Fenn will once more turn to the design and building of special machinery in which they have majored for three generations. The experience of Fenn engineers and machine builders will be available to industry in the days ahead. If you are thinking of new machinery, or improving old designs for efficient production, why not have a talk with our men? It's time to plan Now.

THE FENN MANUFACTURING CO.

HARTFORD, CONNECTICUT

FATIGUE

DOUGLAS · NORTHROP · BUDD · CURTISS WRIGHT · LOCKHEED · BELL · BREWSTER · BOEING · MARTIN · CHRYSLER · NORTH AMERICAN · FAIRCHILD · SIKORSKY · CONSOLIDATED · GOODYEAR

FATIGUE — physical and mental — is a real "harrar-of-war" — more constant than danger. To help defeat this persistent enemy more than one hundred advanced Warren McArthur designs in military airplane seating are now protecting and improving the efficiency of our fighting fliers on every battle front.

WARREN McARTHUR CORPORATION

ONE PARK AVENUE NEW YORK CITY

DESIGNERS, ENGINEERS AND MANUFACTURERS OF AIRCRAFT AND NAVY SEATING

PILOT'S • CO-PILOT'S • NAVIGATOR'S • RADIO OPERATOR'S • REAR GUNNER'S • CAMERA OPERATOR'S • FLIGHT ENGINEER'S • NAVY PATROL STEERSMEN • BOMBARDIER • WARDROOM • OBSERVATION AND TRANSPORT SEATS

UNWELCOME VISITOR

Closing for a kill—it's the sub's deadly enemy... the enemy that hnlped tn break the back of the undnrsens campeign against Allied shipping. Sut the kill will be no pushover. Thn sub fights savegely and desperately . . . thn actinn is hot and swift . . . the piiat depends on the efficient performnnce of his equipmnnt.

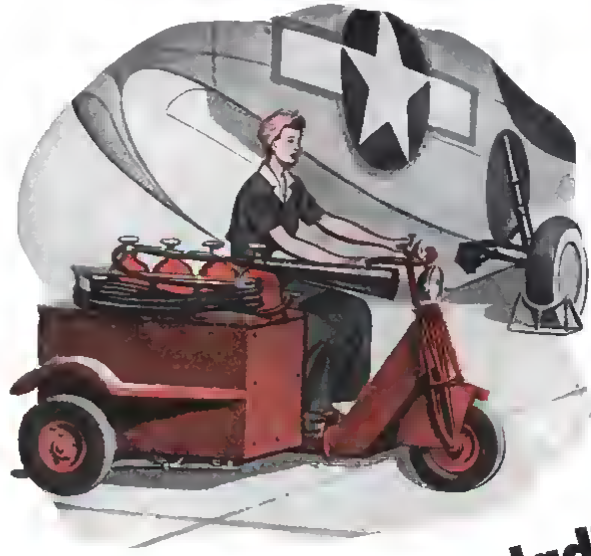
Thnse Delcn motors, far instnnce, mustn't go wrong, for cnmbat makes thnm "tremendous trifles." Those Delco motors won't go wrong, for they am built with extreme care and precision to meet oir-bome nquimments. Defmster fans, mechine gun mnunts, fuel pumps, air pumps, windshinid wipnrs and instrumnnts are actuated by compect, lightweight Delcn motors.

Thn full measure of Delca Products' engineering and manufacturing experience os a leading pmducer of nlectric motors hos been applied to this assignment. Delco Products Division, Genenl Mntors Corporation, Dayton, Ohio.

BUY MORE BONDS—
Double What Ysu Did Before

DELCO MOTORS

DELCO PRODUCTS *DIVISION OF* GENERAL MOTORS



Crash truck . . . ladies' size

Scooters, "manned" by women, rush to fires at air fields and quickly snuff out blazes with carbon dioxide gas from Kidde extinguishers. These midget fire engines are highly maneuverable, easily operated by women. And they're swift — to match the fast fire-killing effect of Kidde extinguishers.

Kidde extinguishers are used by air fields on a wide variety of mobile equipment. They're carried on full-size emergency trucks, two-wheeled trailers, jeeps, motorcycles. Kidde hand and wheeled portable extinguishers stand ready to nip smaller fires.

If you are planning fire protection for an airport—or for aircraft—Kidde's broad experience in aviation fire fighting will be valuable to you. Our engineers are at your service... just drop us a line!

WALTER KIDDE & COMPANY, INC., 140 CEDAR STREET, NEW YORK 6, N. Y.

It's Houdaille's Job, Too!

Underneath the pilots of this fast-landing bomber is a nose wheel.

Formerly, its tendency to shimmy violently was a major threat to safe landings and take-offs.

Today—on thousands of fighters and bombers, and on the tail wheels of huge cargo planes—the Houdaille* Hydraulic Shimmy Damper keeps these pivoting wheels in firm grip which "tightens" as shimmying forces mount and relaxes when slow speed steering movement is desired.

• The Hydraulic Shimmy Damper is only one of the products which Houdaille-Hershey is producing in quantity for the aviation industry.

HOUDAILLE-HERSHEY CORPORATION
GENERAL EXECUTIVE OFFICES: DETROIT

*Pronounced—Hoo-dye

MANUFACTURERS OF PRECISION PARTS AND EQUIPMENT FOR THE AUTOMOTIVE . . AIRCRAFT . . . RAILWAY . . MARITIME . . ELECTRIC REFRIGERATION . . . RADIO AND OTHER INDUSTRIES

NOW! AUTOMATIC CONTROL FOR OIL SYSTEMS

Pre-heating oil to correct operating temperature in engines on the test stand is important in reducing engine wear, securing accurate test results and shortening testing time. To provide dependable oil temperature regulation, Jacobson engineers designed a method for *automatic temperature control* of the oil preheating system on Jacobson Engine Test Equipment.

This method of "Thermostat Control" is another improvement which reduces the possibility of human error and steps up the efficiency of modern engine testing techniques. It is typical of the work Jacobson is doing in seeking constantly to find better ways of doing things in the design, engineering, installation and service of engine test equipment.

JACOBSON & COMPANY, INC.

ENGINE TEST EQUIPMENT

EXECUTIVE OFFICES: 335 EAST 45th STREET, NEW YORK 17, N. Y.
In Canada: JACOBSON & COMPANY CANADIAN LTD., MONTREAL, P.Q.

These Grimes Aircraft Lights and many others in our complete line fly with our boys on every fighting and bombing mission. Through cloudy skies and flak-filled night, they help guide them to their objective and safely home again.

Many of these lights have been developed by our engineers to meet specific requirements of the air forces. Others are war adaptations of original Grimes peacetime types. All have proven the soundness of their basic design under the most trying conditions ever faced by lighting equipment.

This "tried by fire" will serve as well in designing the aircraft lighting we shall offer commercial and private flying when peace comes.

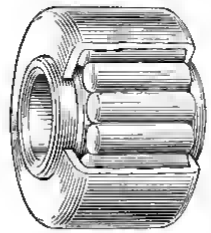
GRIMER MANUFACTURING COMPANY, Urbana, Ohio

If it's Aircraft Lighting...

GRIMES

Designs and Makes it!

Here's Another New Needle Bearing in The Torrington Line



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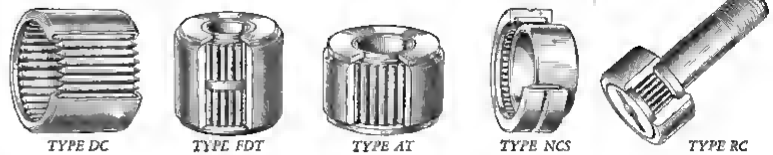


TYPE DC TYPE FDT TYPE AT TYPE NCS TYPE RC

THE PN TYPE NEEDLE BEARING, DESIGNED PRIMARILY FOR AIRCRAFT PULLEYS, OFFERS INTERESTING ADVANTAGES IN OTHER THAN PULLEY APPLICATIONS

•

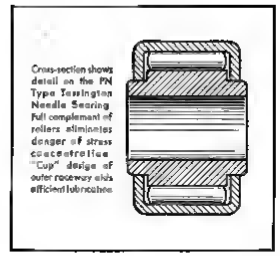
The most recent addition to the types of Torrington Needle Bearings currently available is the PN Needle Bearing designed for aircraft pulley applications.

Utilizing the Needle Bearing principle of a full complement of small diameter needle rollers, this new addition to the Torrington line offers the same basic advantages as the other types: high radial load capacity, light weight, compact size, efficient lubrication, ease of installation, and, of course, gives the desired ease and "feel" of anti-friction operation.

Standard (Army and Navy Specification AN-FF-P-796) Aircraft Pulleys equipped with the PN Type Torrington Needle Bearing are currently available. They offer plane builders another opportunity to utilize the same advantages which have made Torrington Needle Bearings so widely used by the industry, particularly in aircraft control applications.

Other Applications Foreseen

The sturdy construction and simplicity of the design of the PN Type Needle Bearing, as illustrated in the accompanying x section, suggests that it will find many uses in applications other than aircraft pulleys where a compact, high capacity, low cost anti-friction unit can be employed. It is installed by a simple press fit into the outer "housing" and the bore of the inner race fits directly over the shaft or axis.



If you are interested in either Needle Bearing equipped aircraft pulleys or in the application of the new PN Type Needle Bearing for other uses, our engineering department will gladly provide more information. Further data on the features and advantages of this and other types of Torrington Needle Bearings will be found in our Catalog No. 114 available on request. Write for your copy today.

• • •

THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend 21, Ind.

"Makers of Needle Bearings and Needle Bearing Rollers"

New York Boston Philadelphia
Detroit Cleveland Seattle
San Francisco Chicago Los Angeles
Toronto London, England

TORRINGTON

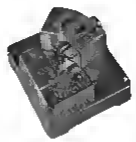
NEEDLE BEARINGS

MAMMOTH

... or midget

OLOFSSON

Designers of Tools, Dies, Jigs and Fixtures
Designers and Builders of Special Machines



IT required the same high degree of skill to produce the mammoth 15-ton die for stamping out a body section as it did to build the small precision gage for checking electronic equipment. These jobs represent Olofsson versatility at its best. Two important manufacturers turned these assignments over to Olofsson because they respected and trusted Olofsson ability. You may at some time require the like of Olofsson skill.

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Every Gulf Cutting Oil has specific properties which insure better performance on certain types of cutting jobs—probably the kind of jobs you have in your plant!

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Call in a Gulf Service Engineer today and ask him to show you how Gulf Cutting Oils can help improve machine shop efficiency. For your copy of the booklet on Gulf Cutting Oils—which includes a helpful 45-page machining guide — send the coupon below.

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The "Queen Mary" in battle dress is now serving her country faithfully and well. Contributing to her dependability are more than ten million rivets (which we estimate would, if laid end to end, reach approximately 283 miles) that fasten her plates, bulkheads and structural parts tight and firm against the destructive forces of time, severe service and storms. The tremendously important cargoes she carries and the need for continuous high speeds, makes it doubly important that all items—from the mighty turbines to the sturdy rivets—fulfill their particular functions.

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Use dependable bolts, nuts, rivets, screws!

Are you now designing your "Products of Tomorrow?" If you want to build them *solidly* and *well*, use headed and threaded fasteners.

For decades, bolts, nuts, rivets and screws have been recognized as the *dependable* means of joining parts. They have been constantly improved through advanced manufacturing methods that provide greater accuracy, higher strength, harder surfaces, protective coatings and other aids to speedy assembly, long life, tight joints. Your products are always safe with Fasteners!

We shall be glad to place your name on the list to receive, free, copies of the informative bulletin FASTENERS, issued at regular intervals

American Institute of Bolt, Nut and Rivet Manufacturers

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Symbols of Freedom

Musket and Powder Horn, 1775 . . . the soldier who carried these in the revolutionary war helped make America free. Perhaps he loved freedom . . . although it is possible that he took up arms because of a recruiting poster of the period which promised "A bounty of TWELVE dollars, together with SIXTY dollars a year in gold and silver on account of pay."

United States War Bonds, 1944 . . . purchase of these to the limit of your resources will help keep America free. If more than patriotism or love of freedom is needed, there is that "bounty" of TWENTY-FIVE dollars on every seventy-five dollars invested in the finest "securities" on the market today.

Allied Products Corporation and its divisions, Richard Brothers and Victor-Peninsular, in Detroit and Hillsdale, Michigan, are making precision parts for guns, airplane engines and other materiel of war. They also make the original, patented R-B interchangeable Punch and Die, sheet metal dies, plastic molds, jigs and fixtures, cold forged parts, and other special products. All four plants have now added a star to their Army-Navy 'E' pennants.

ALLIED PRODUCTS CORPORATION
Executive Offices: 4646 Lawton Ave., Detroit 8, Michigan

5TH WAR LOAN

Let's All Back The Attack

Get this NEW SLANT ON CABLE ASSEMBLIES

• For the cable assemblies that go into your products you can use Amphenol-made cables and save precious time and money at every step. Amphenol has the equipment, the skill, the experience and the production line set-up to make them on a mass production basis—and make them properly. Such assemblies will be manufactured exactly in accordance with your specifications.

Amphenol makes not only the cables but the parts that go into them. Why not eliminate the details and the costs that enter into the procurement and control of the many components of cable assemblies. Amphenol's service also eliminates for you the cost and maintenance of all tools and testing equipment that are necessary and the personnel complications that go with them.

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Something new has been added to engine cylinders . . . a new process to lengthen cylinder life and give the engine greater reliability . . . more hours of continuous operation.

PORUS-KROME, applied to cylinder bores by the Van der Horst process, multiplies cylinder life 4 to 20 times, ring life 3 to 5 times, and reduces the risk of piston seizure.

PORUS-KROME isn't anything like the chromium most people know, decorative chromium, except that both are chromium. It is 250 to 750 times thicker than decorative chromium and isn't bright and beautiful because it is a bearing surface and contains thousands of tiny pores or pockets which retain lubricating oil.

The application of PORUS-KROME varies because every engine is different and has its own characteristics of operating conditions and wear experience. The Van der Horst process begins with a study of wear rates, service requirements, etc., which form the basis for the specification of the work to be done.

Our engineers are ready to make this preliminary study with your engineers at your convenience. In this way, you can have the facts before you when deciding on improvements to be made in your postwar engines.

VAN DER HORST

PORUS - KROME

Multiplies Engine Life

VAN DER HORST CORPORATION OF AMERICA CLEVELAND 11 • OHIO
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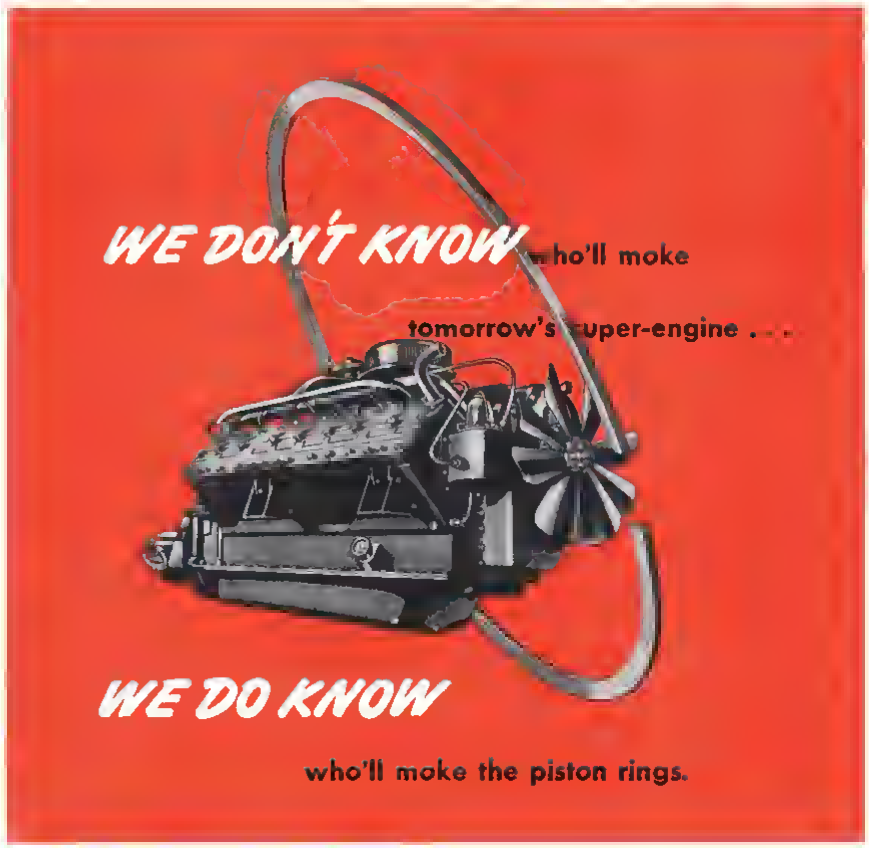
AN AFFILIATE OF BORG-WARNER CORPORATION



The new engine you've been hearing about, that will work miracles in performance and economy, hasn't just been waiting the end of the war. It has been waiting development of a piston ring that would stand the tremendously increased mean effective pressures involved, and give the improved anti-scuffing and long wearing qualities required.

In the finest, largest and best-equipped ring research laboratory in the country, American Hammered engineers have worked day and night on the problem . . . and as usual have come up with the answer. Within the past six months they have developed rings having DOUBLE any previous strength. With the PORUS-KROME* treatment, these rings will let engine builders design far ahead of past possibilities. Koppers Company, American Hammered Piston Ring Division, Baltimore, Md.

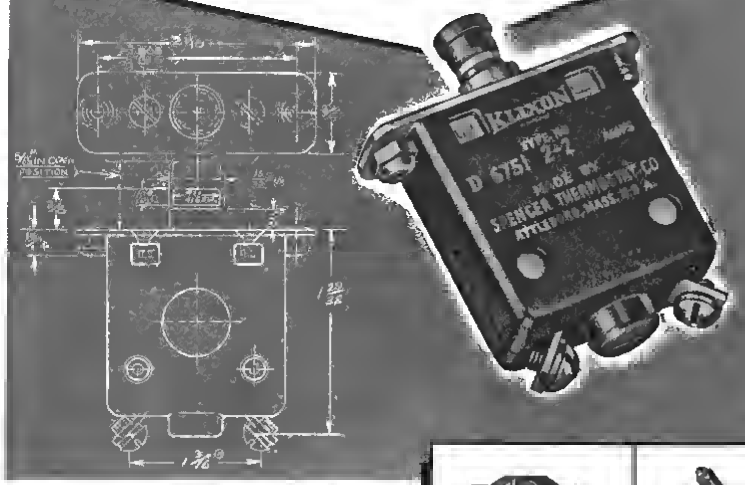
* (VAN DER HORST PROCESS)

The only Army-Navy "E" awarded for piston ring production

NEW

KLIXON "PUSH-PULL" AIRCRAFT BREAKER

Permits opening circuit at breaker For Service Work



Newest Spencer contribution to the aviation industry is the new Klixon D-6751 push-pull indicating circuit breaker. The pull feature permits maintenance crews to *open the circuit manually at the breaker* for de-energizing the circuit for service work. The pull to the "off" position requires deliberate action and retains the desirable feature of being safe against accidental tripping when operating adjacent switches.

Like all Klixon Aircraft Breakers, such as those illustrated at right, the D-6751 gives positive protection against harmful overloads but is unaffected by harmless transient shorts. It is available in ratings from 5 through 50 amperes in both trip-free and non-trip-free types.

Send for complete information on this new Klixon push-pull breaker.

Klixon Push Breakers, P-M-T ratings from 5-40 amps. P-L-M—1½" ratings from 35 amps. through 150 amps.

Klixon Switch Breakers, C-6363 ratings from 5-35 amps. D-6364 ratings from 35 amps. through 150 amps.

Klixon PSM Push Breaker. Same mounting dimensions as standard AN mechanical toggle switches. Ratings up to 35 amperes.

Klixon Remote-Control Breaker. Available in three frame sizes with ratings from 35 amps through 200 amps for circuits up to 30 volts D. C.

KLIXON

SPENCER THERMOSTAT COMPANY, ATTLEBORO, MASS.

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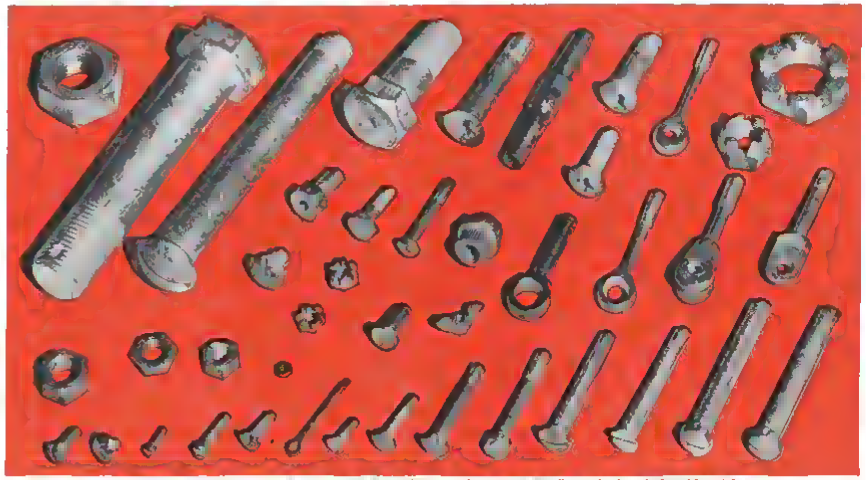
EVERY EIGHTH WORKER IS AN INSPECTOR



As a principal source of supply for aircraft fasteners, National Screw produces an except ionally complete line of AN and NAS bolts, nuts, screws, rivets and other headed and threaded products, including many "specials" designed by individual aircraft manufacturers.

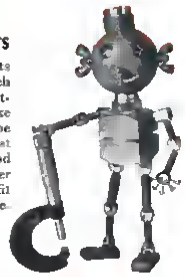
Because we know that rigid inspection is the best insurance of quality, our inspection department comprises 12 per cent of our factory personnel. This results in a standard of uniformity and freedom from rejection that is extraordinary in the industry.

National's engineering and metallurgical experience, modern manufacturing and heat-treating facilities, large capacity and closely integrated production layout, including our own wire mill, equip us to give our customers exceptional service.

Substantial savings to our customers have been effected in many cases by cost cutting methods which we have developed, particularly in adapting cold heading to many parts previously made milled from bar.

SPECIAL AIRCRAFT PRODUCTS

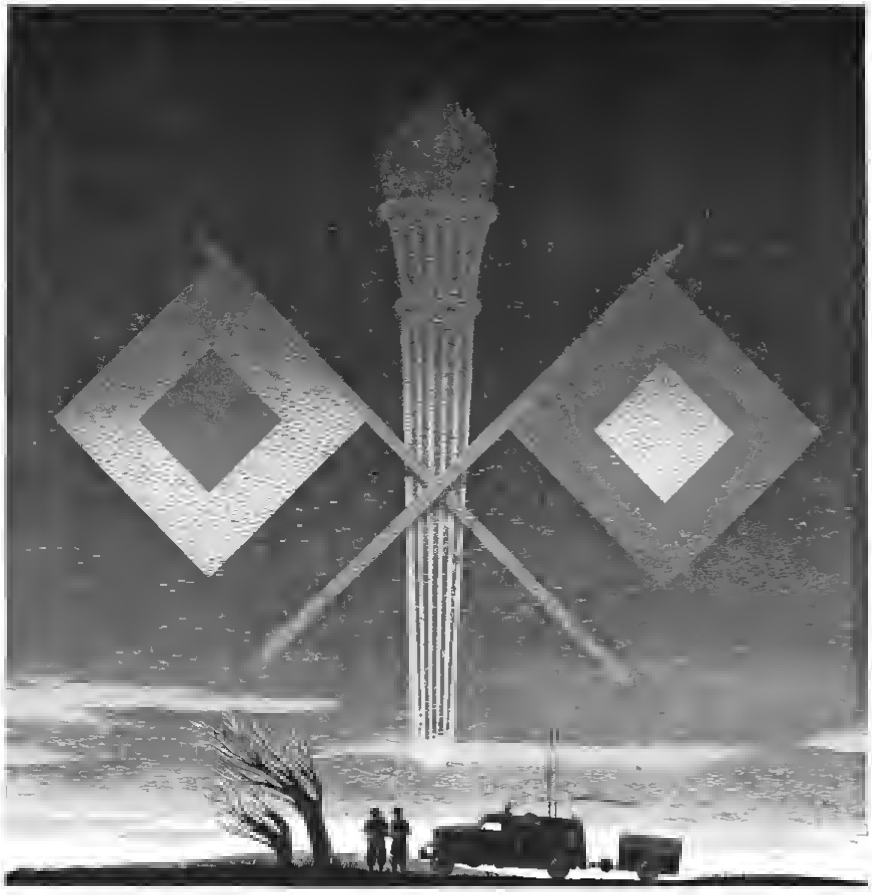
NATIONAL aviation products include many special parts, such as carburetor studs, motor mounting bolts, stainless eyebolts, brake adjustment screws, gyroscope struts, dome nuts—to name just a few. Our engineers will be glad to work with you on any fastener problem and give you the benefit of *National's* wide experience.



National

HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.



A TRIBUTE to the members of the Signal Corps, United States Army, for their great achievements in the field of military communications. On every front, from the development laboratory to the most remote outpost, they are doing their job superbly well.

Hallicrafters employees are proud of the part they are privileged to take in the design and production of radio equipment for the Signal Corps.

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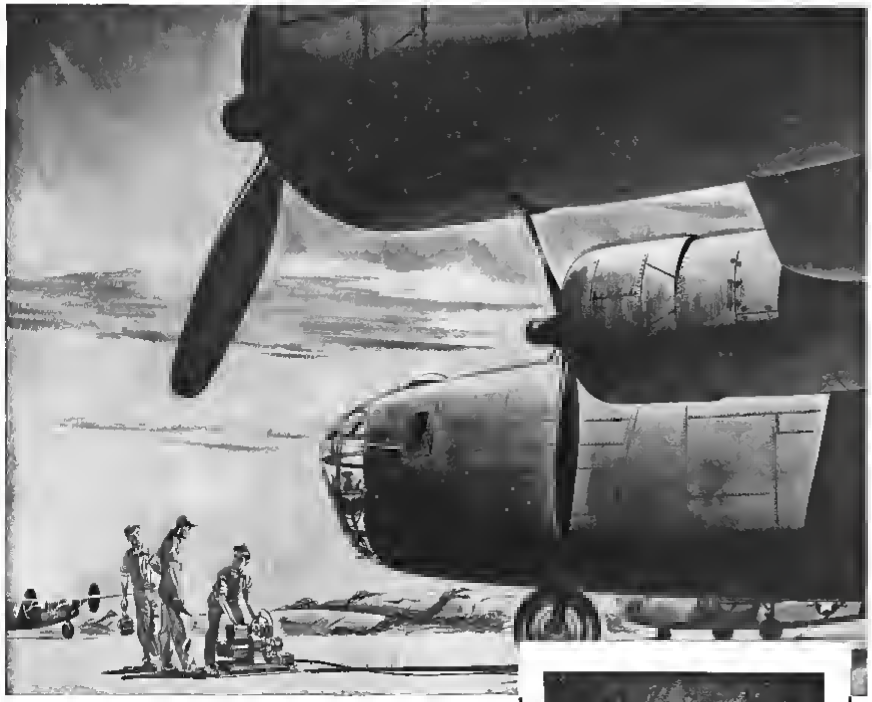


They make bombers Fighting Mad

Bombers are pretty peaceful articles resting on the ground. But up in the air they're different birds. There's fire in their eyes.

What happens between the minute a bomber rolls out of a hangar and the time it takes to the air? Brother, you should see!

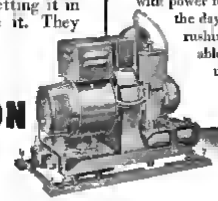
The busiest group of men you'll ever know start working on their pet. They gas her up. They stow the bombs. They check everything on the plane. And off to the side you'll see (and hear) the purr of the ground crew's faithful "putt-putt."

It's a Homelite Portable gasoline-engine-driven Generator — small, compact and *busy* . . . working for all it's worth, furnishing power for charging the plane's batteries and testing its electrical equipment . . . helping the boys in the ground crew to get the plane fighting mad.

It's not an easy life sparring with a bomber . . . getting it in fighting condition. But Homelites are able to take it. They do the job.

They Improve Dispositions

On the home front, Homelite gasoline-engine-driven generators are a blessing to busy construction men. Speeding up work with power for electric tools . . . stretching the day with night time lighting . . . rushing to emergencies with portable power . . . these Homelite units are always on the go.



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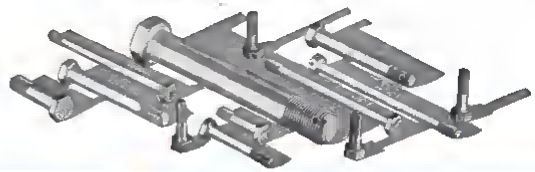
a Cleveland-developed method producing greater strength and accuracy



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MADE BY THE ORIGINATORS OF THE KAUFMAN PROCESS FOR GREATER STRENGTH AND ACCURACY

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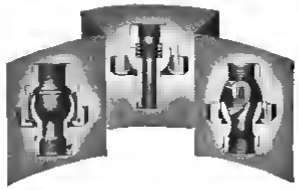
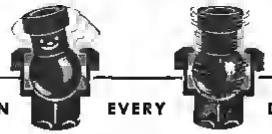


BARCO ***FLEXIBLE JOINTS***

Not just a swivel joint... but a combination of swivel and ball joint with rotary motion and responsive movement through every angle.



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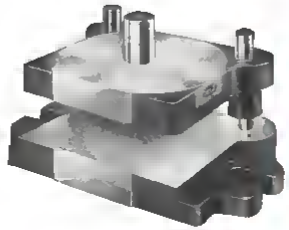

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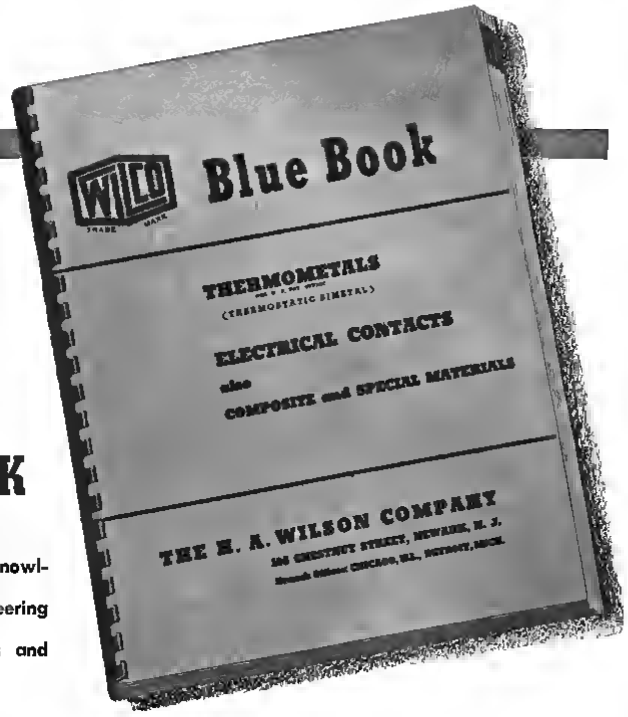
An authoritative treatise—acknowledged as a complete Engineering Handbook on Thermometals and Contact Materials.



The Wilco Blue Book deals with the 29 Wilco Thermometals (thermostatic bimetals)—what they are—how they are made—their properties, functions, applications and temperature ranges. Particularly outstanding are the 37 pages of formulae and charts, which give detailed graphic data regarding deflection rates, corrosion resistance characteristics, resistivity, etc. A large part of the Thermometal section is devoted to formulae on the behavior of various shapes and types.

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"A model for supplying the information needed by engineers for their use of manufactured products."

"A maximum of factual information—a minimum of adjectives."

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Give "Green Hands" Blue Flash Performance

Here's help for "newcomers" . . . cut-off wheels that compensate to the fullest possible extent for workers' undeveloped skill . . . wheels that cut clean, free and straight with minimum amount of burr and burn . . . wheels that weather rough treatment.

Train "green help" to recognize features that add finesse to the quality of their work. With Bay State resinoid-bonded, rough-sided cut-off wheels, they get freer cutting action, longer life. Discoloration and heat are minimized because contact surface area is noticeably reduced.

Bay State makes wheels for every type of cut-off machine . . . rubber-bonded wheels for wet operations, resinoid-bonded wheels for dry. Constant rigid laboratory inspection of raw materials . . . modern ovens with delicately-set temperature regulators . . . and other factory refinements contribute to the mounting reputation for leadership of Bay State "Blue Flash" cut-off wheels just as they do for Bay State's complete line including all types of grinding wheels and other molded abrasive products. Bay State's reputation for honing and superfinishing stones is unexcelled.

Test a wheel to see how Bay State quality helps "green hands" and veterans too. For additional details get Bay State's Cut-off Bulletin. Write . . .

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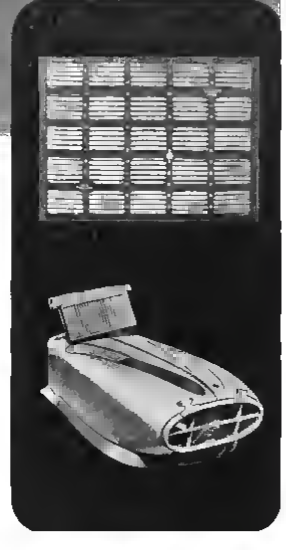
GRINDING WHEELS · HONING AND SUPERFINISHING STONES · PORTABLE SNAGGING WHEELS
MOUNTED WHEELS AND POINTS · CUT-OFF WHEELS · INSERTED NUT DISCS AND CYLINDERS

Efficient Filtration, another Battle won . . .



THERE are many other aspects of battle than the clash of steel, artillery duels or fights to the finish in the air. Ask the engineers what it means to battle against the havoc wrought by torrential rains, hurricanes and those bitter enemies frost, ice and snow.

There are yet other enemies to be conquered — dust and, especially in the North African and eastern battle areas, SAND — the relentless fighter against efficiency of aircraft and mechanised units of the Army.

Vokes Filters have helped to win these battles against Sand. Special types of Vokes Air, Oil and Fuel Oil Filters are fitted to machines for the R.A.F. and mechanised units operating in desert battle grounds to the satisfaction of Government experts, pilots and the men who keep aircraft, tanks, lorries, etc., fighting fit.

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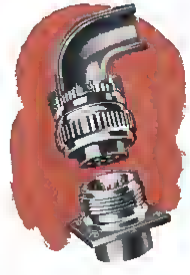
Speed of overhaul and replacement of vital equipment is an important factor today in the efficient operation of both military and commercial aircraft. It is a factor which depends in great part on the speed with which hundreds of electrical connections can be made or broken. Breeze Multiple Circuit Electrical Connectors provide a solution to this problem, making it possible to connect or disconnect from 1 to 47 circuits instantly and simultaneously.

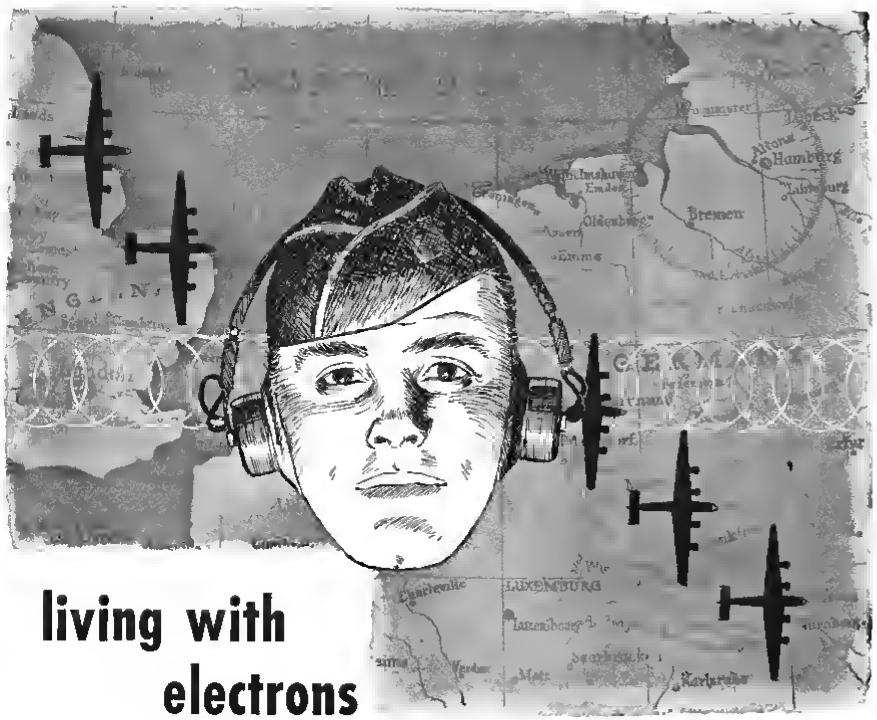
Manufactured in a wide range of types and sizes, Breeze Connectors are designed to meet practically every need in modern electrical control and communications systems. Produced in quantity to latest A-N specifications, these Connectors supplement the well-known Breeze line of aircraft accessories that are playing such an important part in the United Nations' drive to Victory.



Cutaway view of Breeze Connector showing simple design and split-case construction.

Breeze BREEZE MARK CORPORATIONS, INC. NEWARK, N.J.

PRODUCTION FOR VICTORY • PRODUCTS FOR PEACE



living with electrons

Only a short time ago—when the principles of radio were discovered—men began dimly to realize the versatility of electrons. But it was not until war came, with its deadly challenges, that men really began living with electrons, utilizing them in amazing applications in ships and planes and battle vehicles. Their versatile performances promise future applications that will make electronic devices a part of our daily lives.

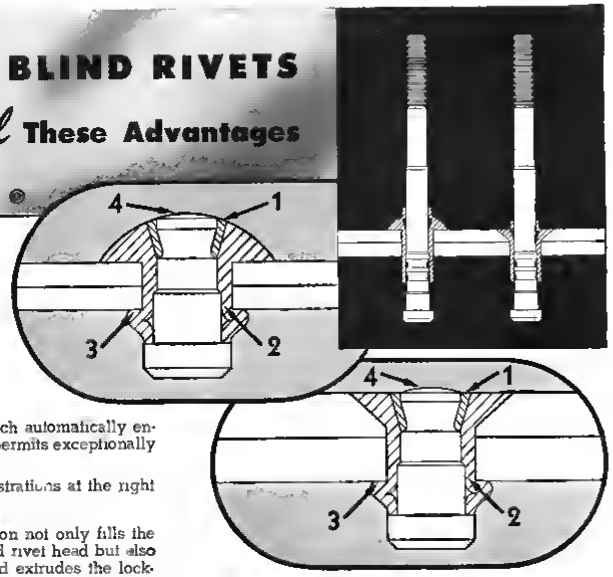
Delco Radio has been working in close cooperation with Army and Navy engineers to help make electronics an increasingly effective "weapon" of war. The assignment has called for full utilization of Delco Radio's research laboratories, engineering background and production facilities, by means of which principles have been explored and exploited, designs evolved to apply these principles, and complete equipment manufactured with speed and skill. To all radio and electronic applications, Delco Radio brings its long experience in volume production of precision radio instruments.

DO MORE THAN BEFORE—
BUY MORE WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

ELECTROL INCORPORATED • KINGSTON, NEW YORK • HYDRAULIC EQUIPMENT FOR AIRCRAFT

The *Only* BLIND RIVETS Offering *All* These Advantages



HUCK BLIND RIVETS, by virtue of a positive mechanical lock between the pin and sleeve accomplished during the driving operation, become the equivalent of a one-piece solid rivet with considerably greater ultimate shear strength than conventional A17ST (Type AD) or 17ST (Type D) icebox solid rivets. A "pull type" compressed air gun, the jaws of which automatically engage the rivet pin pull grooves, permits exceptionally simple and rapid application.

Identified by number in the illustrations at the right are these features:

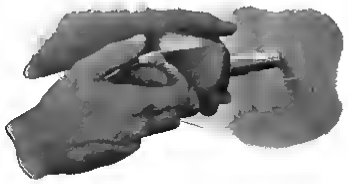
1 The one driving operation not only fills the hole and forms the blind rivet head but also automatically shears off and extrudes the locking collar to form a conical keystone lock. This resulting positive mechanical lock precludes the possibility of the pin working out under any conditions of fatigue loading or vibration and, of equal importance, increases the tensile strength of the rivet to permit full use of the bearing value of sheets because the joint will not become critical in rivet tension.

2 The first part of the pin movement, prior to blind head formation, expands the sleeve to completely fill the hole. This insures joint rigidity, fatigue life, and resistance to vibration and reversal of stress loading.

3 As a result of special work hardening of the sleeve end, the sleeve upsets by forming a bulb rather than a tulip head. As the lower part of this bulb forms in the hole, completion of the bulb pulls the sheets together with great force, flattening the bulb against the sheet and thus providing surface contact between the blind head and the sheet.

4 The last part of the driving operation automatically severs the pin substantially flush with the rivet head contour. This eliminates the necessity of further trimming except where the ultimate in aerodynamics is required. It also makes possible inspection from the driving side, as an unsatisfactory blind head resulting from the use of an improper grip length or any other reason will be instantly detected by the resulting improper relationship of the pin break to the sleeve contour.

Another New HUCK BLIND RIVET



Developed Especially For Emergency Repair Work

For emergency repairs, it is often considered desirable to sacrifice some strength for simplicity. To meet this demand, Huck has developed a special hole-filling blind rivet forming a tulip blind head with no lock other than friction between the pin and sleeve. This is a universal rivet in that one grip length will suffice for any combination of sheet thicknesses from .050" to .300".

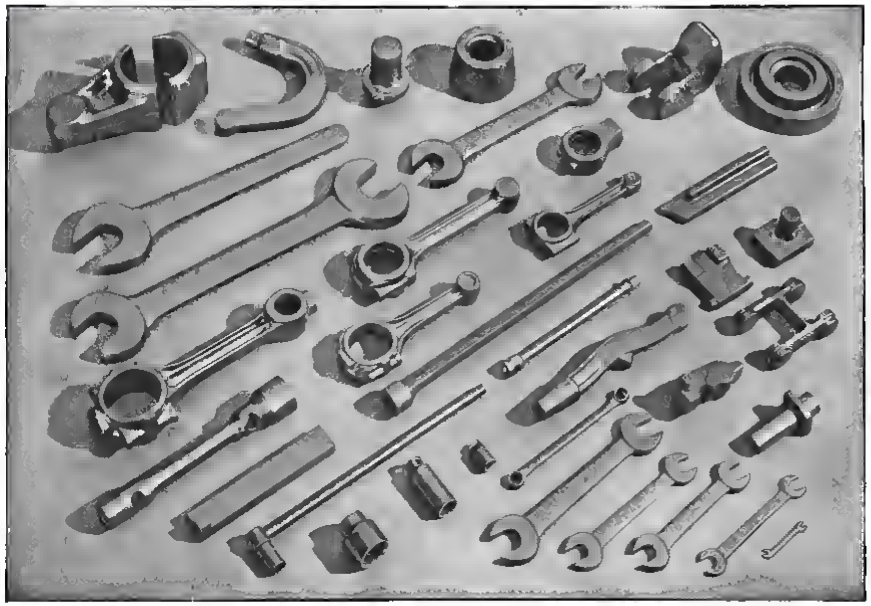
An extremely efficient yet very small hand tool weighing about 2 lbs. has been especially designed for field repairs. This small gun will drive 1/8", 5/32" and 3/16" diameter rivets in either brazier or countersunk types without any change or additional accessories.

Huck Blind Rivets are now available in 1/8", 5/32" and 3/16" diameters with AN456 Brazier, 78° Modified Countersunk and 100° Countersunk heads.

ALSO PRODUCED BY HUCK—Skirted Solid Countersunk Rivets for Cam Press Dimpling and Parts Dimpled Simultaneously. All Types of Solid Conventional Aircraft Rivets including Aluminum Alloys and Monel Metal AN Standards.

Huck MANUFACTURING COMPANY
Specialists in Aircraft Riveting Processes
2474 BELLEVUE AVENUE • DETROIT 7, MICHIGAN

BOLTON MANUFACTURING CORPORATION
692 CAMPBELL AVENUE · WEST HAVEN · CONNECTICUT



Herbrand

PRECISION FORGINGS

Upset or Drop Forged--Any Shape or Size up to 200 lbs.

You who use forgings in war production work won't have a problem of faulty forgings if the job is being done by Herbrand. Our expert hammersmiths, who have made forging their life business, maintain uniform dimensions and close tolerances producing forgings which are free from defects.

Since our organization was founded in 1881, Herbrand has never lost sight of the importance of producing quality products conforming to exacting specifications

Today the counsel of the Herbrand engineering staff is available to help solve present war production problems, or for post-war planning . . . Your inquiries are solicited.

THE HERBRAND CORPORATION
FREMONT, OHIO

WORTHY WEAPON

America's fighter pilots using Allison-powered planes are downing the enemy on every battle front. ★ Allison engines by superb performance have proved their ability to take punishment, their smoothness to lessen pilot fatigue, their economy to provide long range. ★ These engines — worthy weapons today — will contribute to the comfort and safety of the planes you will ride in tomorrow.

POWERED BY ALLISON:
P-38—Lightning
P-39—Airacobra
P-40—Warhawk
A-36 and P-51A—Mustang

More than 50,000 Allison engines have been built for the above planes of the U. S. Army Air Forces.

BUY WAR BONDS DO MORE THAN BEFORE

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF GM GENERAL MOTORS

Indianapolis, Indiana

Every Sunday Afternoon—GENERAL MOTORS SYMPHONY OF THE AIR—*NBC Network*

The WILSON "HONEY BEE"
ARC CONTROL STATION

In leading aircraft plants—and wherever thin metals are welded—the Wilson "Honey Bee" is the "first choice" with operators and management. Three outstanding features explain the "Honey Bee's" widespread acceptance:

1. It permits better welds on thin metal because of its Remote Crater Control—a mechanical device which fades out the arc slowly to positively prevent craters, porosity, and burn-through.

2. It provides more arcs per generator, since two or more "Honey Bee" stations operate from each constant potential generator.

3. It increases productive welding time through its Remote Arc Control, which enables each operator to regulate current from zero to maximum while welding—without first extinguishing the arc.

The "Honey Bee" is made in 75 amp and 150 amp sizes. As a power source for "Honey Bee" stations, the Wilson "Hornet" generator is preferred throughout industry. With its convenient quick change switch, the "Hornet" may be converted from standard to constant potential characteristics, and vice versa as required.

Use the coupon to obtain by mail further details on the Wilson "Honey Bee" and Wilson "Hornet".

★ Buy United States War Bonds ★

WILSON

WILSON WELDER and METALS CO., INC.

General Offices: 60 East 42nd Street, New York 17, N. Y.

In the U.S.A. WILSON AC WELDERS — distributed through the Air Reduction Sales Co
In Canada: H. R. Peters & Co. of Canada Limited, Birks Bldg., Montreal

Wilson Welder & Metals Co., Inc.
60 East 42nd Street F 1
New York 17, N. Y.
Gentlemen:
Please forward to me by return mail catalog data on the Wilson "Honey Bee" and "Hornet" (Forms ADW-47 and ADW 15)

Name ..... Title .....
Firm .....
Address .....
City ..... State .....

KOHLER *Maker of*

PRECISION AIRCRAFT VALVES AND FITTINGS

Kohler of Kohler, backed by 70 years' experience in the manufacture and distribution of quality products, has for more than a year been making aircraft valves and fittings in large quantities and in a wide range of types and sizes to meet rigid Army-Navy aeronautical specifications. Among Kohler aviation customers are the Army Air Corps, Naval Aviation and important aircraft builders in all sections

Kohler Co. has not only the experience and equipment for uninterrupted precision production; it has, too, the forging, machining and anodizing facilities necessary to do the *complete* job. No subcontracting necessary.

Write today for the folders shown—"Kohler Aircraft Valves" and "Kohler Aircraft Fittings." Inquiries get prompt attention. Kohler Co. Established in 1873. Kohler, Wisconsin.

★ BUY UNITED STATES WAR BONDS ★

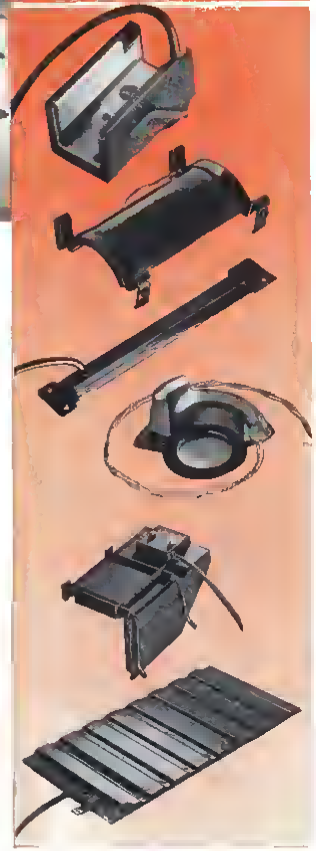
KOHLER OF KOHLER

PLUMBING FIXTURES AND FITTINGS · HEATING EQUIPMENT · ELECTRIC PLANTS

send for this New BOOKLET

It shows how H & A units can be engineered in nearly any size shape and capacity—to maintain heat of exact temperature in mechanical or electronic devices or at critical steps of mechanical or chemical processes.

Write H & A Engineering Department
22 Leroy Avenue, Buffalo 14, N. Y.



Study this war development in

ELECTRIC CONTACT HEAT

... it may answer your problem

● Hundreds of thousands of H. & A. Electric Contact Heat Units—in different shapes, sizes and capacities—are keeping machine guns firing, storage batteries operating, in frigid temperatures as low as 65° F below zero.

Just as our engineers solved, for the first time, the tough problem of heating heavy steel mechanisms by means of a small, light-weight, low-wattage heating unit, so might they be successful in engineering special units to meet *your* requirements.

We invite you to submit any such problem to us.

H & A *Manufacturing Co. Inc.*

PLANTS IN BINGHAMTON AND BUFFALO, N. Y.

"UMBRELLA MAKER — 1944"

To this chap and thousands like him must go the credit for producing the umbrella of planes—both fighters and bombers—which are doing such splendid work over captive Europe. The tremendous power of the Allied air offensive is only possible because the aircraft workers, both men and women, have stayed on their jobs and produced day after day.

But regardless of their efforts, such record production of planes could never have been achieved without machines like *General* Riveters. The high speed and automatic features of these machines enable an operator to produce at rates far in excess of other methods. Savings in manpower run as high as 30 to 1.

For any riveting operation, there's a *General* Riveter to do it most efficiently. Write or wire for information.

GENERAL ENGINEERING COMPANY

785 HERTEL AVENUE, BUFFALO 7, NEW YORK

MULTIPLE RIVETERS — AUTOMATIC MULTIPLE RIVETERS — SINGLE RIVETERS
DIMPLERS — ANVILS — WORK HANDLING EQUIPMENT

Proof of a Better Finish

Surface Analyzer Tape Proves you Get a Better Finish with Chicago Wheels

These results were obtained at a rate of 10 pieces per hour in an aircraft parts plant. Material, X-13-15 Rockwell 60 to 57, grinds out .006 to .007 stock. Chicago Wheel used, ½x½x⅛", Grain 180, Grade L Arcite FV Bond. Spindle Speed 40,000 r.p.m., Lapping and super finishing eliminated on this job.

Can you match that finish? Sounds phenominal, but you can do it with Chicago Wheels. And, the secret of their superiority lies in the new FV Bond, developed exclusively for Chicago Wheels, after 50 years' experience making wheels for the most accurate and precise applications.

Here's What FV Bond Will Do for You

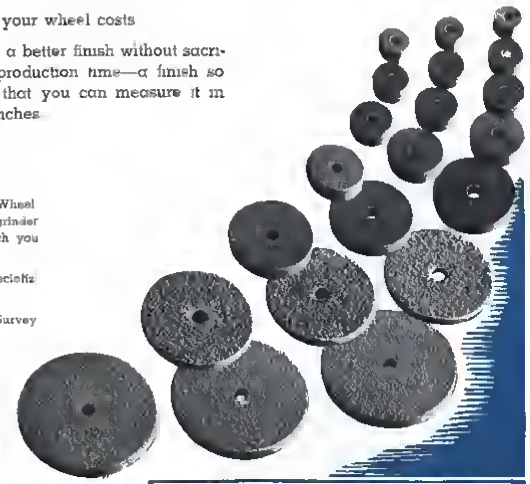
- Reduce your wheel costs
- Produce a better finish without sacrifice of production time—a finish so smooth that you can measure it in micro inches.

TRIAL WHEEL FREE

Write or send the coupon today for a Chicago Wheel made with this remarkable new FV Bond. Tell us grinder you use, size wheel and kind of material on which you will make your test.

For the duration, with full WPB approval, we are specializing on small sizes—anything up to 3" in diameter.

Write for Catalog and one of the new Engineering Survey Forms. A step in the direction of better finishing.



Half a Century of Specialization has Established our Reputation as the Small Wheel People of the Industry

MOUNTED WHEELS — SMALL GRINDING WHEELS

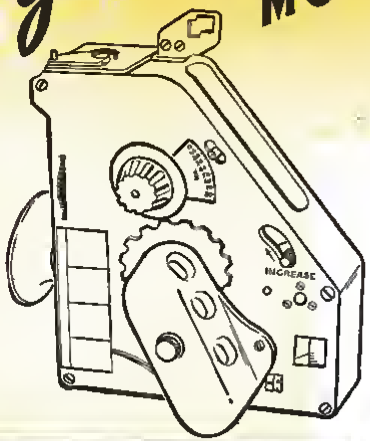
CHICAGO WHEEL & MFG. CO.

America's Headquarters for Mounted Wheels and Small Grinding Wheels

1101 W. Monroe St., Dept. Av, Chicago Ill.

Send Catalog and Survey Form. Interested in
( ) Mounted Wheels. ( ) Grinding Wheels.
( ) Send Test Wheel. Size ____
Name ____
Address ____

Just suppose you asked us to make a MODERN SEXTANT



There's a job! Think of the steps involved. First comes engineering with research, for most successful machines are but the sum of previous efforts—plus improvements. Then a pilot model moving through experimental . . . but we are getting ahead of ourselves.

What we mean to tell you in this ad is that VARD INC. can build units like a Sextant from the drawing board to the finished model in quantity production and never go outside our own plant for anything except raw materials.

Getting back to the pilot model . . . we'd probably make several in experimental with very little tooling. After the design was thoroughly 'shaken down," the item would be tooled for production in quantity. We would make a wood pattern for the chassis of the instrument, mould it in sand, and cast it of an aluminum alloy. Other parts would be cast in permanent moulds. Some parts would be stamped.

Inside the Sextant would be gears and ground parts, precision mirrors, and optical glass parts. There would be accurately machined and engraved dials, etc., of metal and plastic. We can do all that.

To make the instrument look right, and stand the weather, its parts would require anodizing, plating, and enameling. We do that, too!

Next, we'd make a wood, plastic, or metal carrying case. And finally—very important—we'd test the Sextant mechanically and optically—on our own equipment.

In all the hundreds of different operations necessary to complete the pilot models, we have the men and tools to do the job. But here's the thing that makes VARD INC. unique on the Pacific Coast, we also have the equipment and organization that can turn out Sextants in production.

We have the skill accumulated in the production of thousands of aircraft hydraulic and geared parts, navigation instruments, inspection gages and production tools.

If you don't happen to want us to design and build Sextants for you—what do you have that you want to produce in the West—now or after it's all over?

Center your Responsibility and Save Supervision, Time, and Costs!

VARD INC.

PASADENA 8, CALIF.

Thread & Plug Gages • Snap Gages (VARD or JOHN-SONS Type) • Special Taps • Precision Ground Optical Lenses & Filters • High Fidelity Mirrors

SAVE *Time, Labor, Cost*

WHEN CUTTING LONG OR BULKY WORK!

Workpieces of wide area often cause costly jams in production lines — unless you speed the work on its way with versatile Walker-Turner Metal-Cutting Radial Machines and Band Saws.

These fast, accurate machines relieve overworked, heavier cutting units, and even serve as "first line" production equipment on lighter work. Their wide range of speeds brings practically all materials within their scope. Their simple, easy operation makes every man-hour more productive.

Write today for detailed literature.

WALKER-TURNER CO., INC., PLAINFIELD, N. J.

METAL-CUTTING RADIAL MACHINE

Cutting wide metal stock is easy with the Walker-Turner Metal-Cutting Radial Machine. Sliding ram design permits transverse travel of 21½". Geared motor—with saw shaft at bottom edge—permits deep cuts with smaller blades than in conventional motors and effects substantial savings in blade costs. Universal head makes mitering and compound mitering as easy as straight cutting.

METAL-CUTTING BAND SAW

[illegible] profiling irregular dies [illegible] cutting sheets, rods and tubes of steel, iron, aluminum, brass, alloys and composites—these are a few of the jobs Walker-Turner Metal-Cutting Band Saws are doing quickly, accurately, economically. Available in 14 and 16 inch models these rugged, compact machines provide a speed range from 61 to 5300 s.f.m.

walker-Turner COMPANY, INC. PLAINFIELD, N.J. U.S.A.

MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

Once again WEBER FACILITIES and EXPERIENCE have been selected to Produce Vital Aircraft Assemblies

WHEN A HUGE P-38 expansion program was planned, officials of Lockheed Aircraft Corporation and officers of the United States Army Air Force made a thorough study of major Southern California manufacturing plants.

In selecting a sub-contractor to fabricate leading edge wing assemblies, careful consideration was given to manufacturer's ability to satisfactorily meet specifications and delivery schedules. Outstanding production facilities—a remarkable peacetime manufacturing record, plus a three-year background of successful war production caused these aviation leaders to select WEBER for this important job.

Perhaps these Weber production short cuts can speed your aircraft assemblies. Call our aviation division about your specific problems.

A FEW WEBER AVIATION PRODUCTS

Leading Edge Wing Assemblies, De-icer Tanks, Bomb Bay Doors, Nose Wheel Doors, Gunners' Access Doors, Floorboard Assemblies, Compartment Doors, Navigation Tables, Radio Tables, Bombardier Seats, Plywood Wings, Control Surfaces, Hydraulic Press Stamping and Auxiliary Gas Tanks.

WEBER FACILITIES & EXPERIENCE "WORKING FOR VICTORY"

WEBER SHOWCASE & FIXTURE CO. INC., 5700 AVALON BLVD., LOS ANGELES, CALIF. - EST. 1898

Look out for one-way streets!

Exclusive Crown Zipper tooth design makes the Crown zipper track a two-way "street"—sliders work quickly, smoothly, almost effortlessly, in both directions!

Things began to happen fast when Crown Zipper engineers went out into the field with our armed forces to adapt zippers to special military jobs.

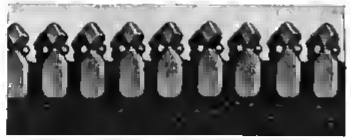
Out of Crown's experience have come five big basic advancements over old-style, conventional zippers (see list below)—and one of the most important of these is the superior construction of Crown Zipper teeth.

If you examine a Crown Zipper closely, you see that both sides of each tooth are identical. This permits sliders to operate smoothly, quickly, almost effortlessly, in either direction along the zipper track.

In addition, this exclusive Crown Zipper tooth design permits two or more sliders on the *same* track—making Crown the only zipper in the world that provides quick, convenient openings at any given point, with smooth closures in *both* directions. (One recent Crown application actually has ten sliders!)

After the war, Crown's new "double-acting" zippers will mean big improvements in aircraft applications—on engine covers, field hangars, many other items.

When *you* turn to postwar, Crown engineers, fresh from their experience in designing hundreds of military items, will adapt—or, if necessary, *create*—special zipper applications to meet special problems



CLOSE-UP OF CROWN ZIPPER TEETH
REVEALS BOTH SIDES OF EACH TOOTH IDENTICAL

CROWN

ZIPPERS

are 5 ways better

1. Takes sharp curves

2. Die-cast for smoother action—extra strength

3. Provides opening wherever you want it

4. Won't lock open

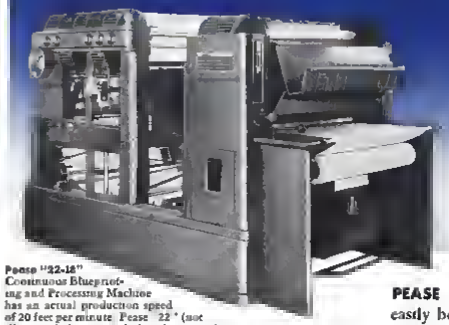
5. Resists corrosion

Member of the J. & P. Coats • Clark's [redacted] *Family*

THE SPOOL COTTON COMPANY • *745 Fifth Avenue, New York, N. Y. (Crown Fastener Division)*

Printmaking Adaptability

ALL TYPES OF PRINTS WITH PEASE BLUE-PRINTING EQUIPMENT



Pease "22-16" Continuous Blueprinting and Processing Machine has an actual production speed of 20 feet per minute. Pease "22" (not illustrated) has a speed of 30 feet per minute

Pease "700" Continuous Whiteprint (Dry Direct Process) Developing Machine only

Pease "K" Continuous Wet Direct Process Developing Attachment for complete Continuous Blueprinting and Processing Machines.

PEASE Continuous Blueprinting and Processing Machines can easily be adapted to meet any printmaking requirements. Using a Pease "22-16" Continuous Blueprinting Machine as basic equipment, you can have a complete printmaking department capable of producing any kind of tracing reproductions by simply using the Pease "700" Multazo Whiteprint (Dry Direct Process) Developing Machine in conjunction with the printer only, or by adding the Pease "K" Continuous Wet Direct Process Developing Attachment to the equipment.

PEASE "22-16" Continuous Blueprinting and Processing Machine is fast, economical and easy to operate . . . makes sharp, clear, contrasty Blueprints, Blueline Prints, Brownprints (Negatives) and Brownline Prints.

PEASE "700" Continuous Multazo Whiteprint (Dry Direct Process) Developing Machine is a table model developer. Prints can be easily and quickly developed on it, after exposure on the Pease "22" Printer or any other printer.

PEASE "K" Continuous Wet Direct Process Developing Attachment, consisting of a developer tank, tray and rolls, is bolted directly to the printer to make Wet Direct Process Prints. The prints are dried and delivered in the same manner as blueprints.

PEASE SENSITIZED PAPERS, made of carefully selected No. 1 paper stock uniformly coated, assure you of sharp line Blueprints, Blueline Prints, Brownprints (Negatives), Brownline Prints and Multazo Whiteprints (Dry Direct Process). For your protection, every roll is wrapped in moisture-proof and light-proof jacket with rip-cord.

Write for Literature and Prices . . .
No obligation, of course

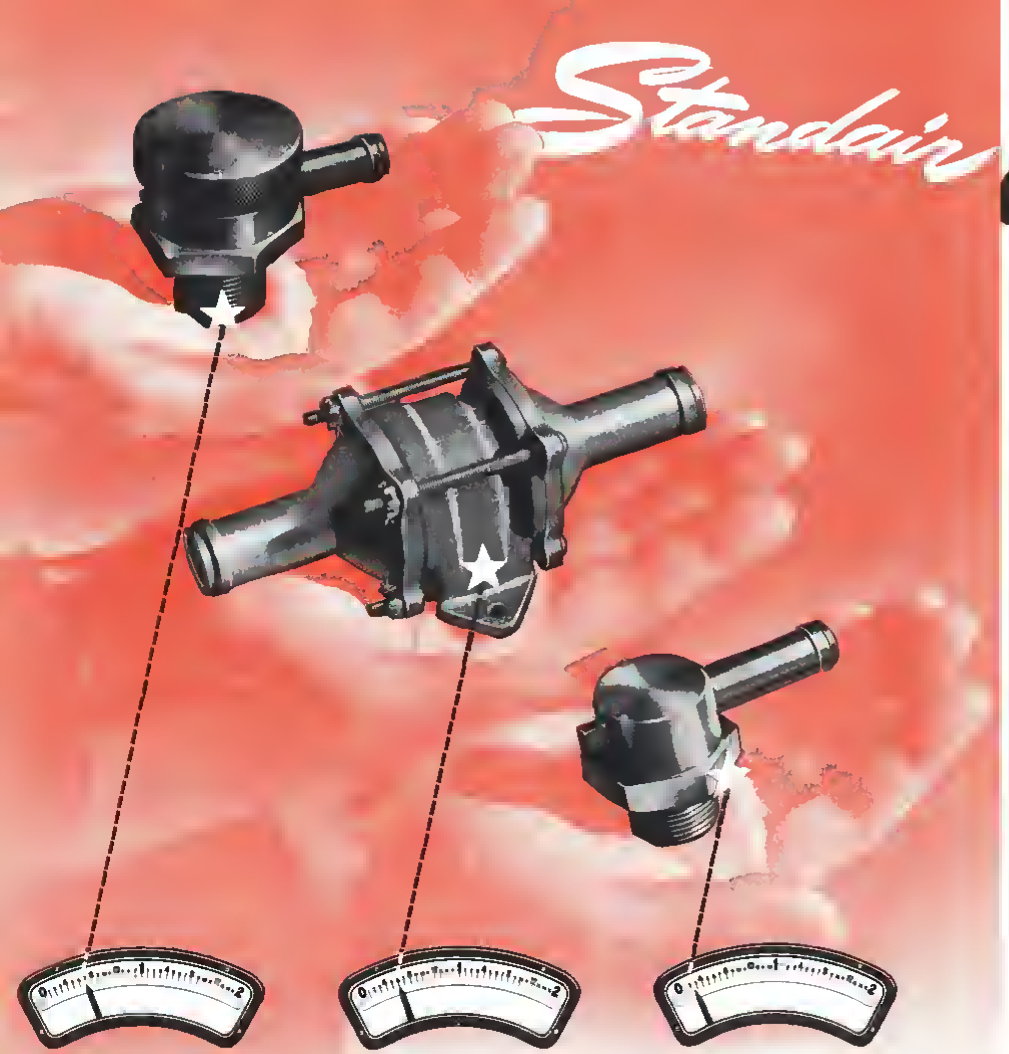
SPECIAL FEATURES FOUND ONLY ON PEASE BLUEPRINTING MACHINES

Sliding "Vacuum-like" Contact smooths tracings, prevents errors in printing • **Three Speed Lamp Control** provides operation at 10, 15, or 20 amperes, minimizes running speed and drier heat changes • **Acilelic "No-Break" Arc Lamps** burn 45 minutes without breaking arc, resume instantaneously • **Horizontal "Floating" Water Wash** floats prints free from tension, prevents wrinkles, stains, bleeding • **Quick Change Chemical Applicator System** economically allows change from Blueprints to Negatives in 30 seconds • **Eight-Inch Diameter Drying Drums,** thermostatically controlled, heated by gas or electricity, dry prints "flat as hung wallpaper."

THE C. F. PEASE COMPANY
2611 WEST IRVING PARK ROAD • CHICAGO 18, ILLINOIS

Pease Blueprinting Machines for all kinds of Tracing Reproductions

Standair Controls for Aircraft Engines



Designed for *Maximum Performance*

. . . plus *Minimum Size* . . .

and *Minimum Weight*

As the efficiency of combat aircraft is increased, more and heavier equipment is continually being added — heavier armor and armament — auxiliary fuel tanks for longer range —new instruments for improved performance and protection. Yet, to meet today's demands for versatility — to function effectively and efficiently in any altitude—the power plants of all modern aircraft require precision controls such as the three Standair products illustrated and briefly described in this spread. However, the weight of all Standair controls has been reduced to the *minimum*. Standair engineers with the "know how" have successfully combined *maximum performance* in the engine controls of their design with *smallest possible overall size and least possible weight*. Standair instruments are being specified in today's efficient fighting craft, and the engineering skill responsible for these exclusive instruments for war will contribute to the development of similar controls for commercial cargo and transport planes when the war is won. Write or wire for complete specification and installation data.

Weight only 7 ounces

Altitude Compensating Pressure Relief Valve

Having many applications, this valve is most commonly used today for pressurizing cooling systems. Maintains a predetermined pressure on the system regardless of altitude. In the event the pressure exceeds the setting, valve automatically opens, relieving excess pressure. Includes a relief valve—admits air to system in event of a vacuum. Overall: 2 9-16" x 1 7/8".

Weight only 6 ounces

OIL PRESSURIZING VALVE

This valve maintains a pressure on the oil system, preventing cavitation of oil. Incorporated in the device is a relief valve which provides for relief in the event a negative pressure develops in the system. The operating pressures for this valve can be furnished to customers' specific requirements. Overall dimensions: Length 5 7/8", width 3", height 2".

Weight only 2½ ounces

PRESSURE RELIEF VALVE

This valve, commonly used in aircraft engine cooling systems, maintains a predetermined pressure, expelling excessive pressures to the atmosphere. It incorporates a relief valve, preventing negative pressures in the system. Overall dimensions: Length 3", width 1½"; height 1¾". For detailed specifications on any one or all of these controls, write or wire.

"STANDARD Products — Standard for the Industry"

Standard Aircraft Products Inc.
DAYTON 2, OHIO

—SALES OFFICES—

Standard Aircraft Products, Inc., 1831 Graybar Bldg., New York City
Hartwell Aviation Supply Co., 3417 Crenshaw Blvd., Los Angeles, Calif.
Hartwell Aviation Supply Co., 608 North St. Paul St., Dallas, Texas
Hartwell Aviation Supply Co., Huron Building, Kansas City, Kansas
L. M. Poyna Company, Inc., 417 Curtis Building, Detroit, Michigan

STANDAIR

Keep Backing the Attack . . . Keep Buying War Bonds!

Here's what the

BRUSH SURFACE ANALYZER

means to Him

Surface smoothness on the vital moving parts of his plane has been measured to one-millionth of an inch by the Brush Surface Analyzer. Such precision assures his safety.

The diamond stylus of this instrument explores surface finishes, and its movement is amplified up to one hundred thousand times, then immediately recorded on a moving paper chart for permanent record.

If accuracy is essential in your business, write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.

THE BRUSH DEVELOPMENT COMPANY

3443 PERKINS AVE. • CLEVELAND 14, OHIO

THE loss of manpower to the fighting forces—men who did the heavy handling—can be compensated for immediately with a TRANSPORTER and a woman operator. In fact your handling can be greatly improved this way as concerns greater speed, many more tons transported per day, and lower costs.

It doesn't take experienced help to aperate o TRANSPORTER and still your handling is raised to its highest point of efficiency. No tie-ups—no stops—no clogging of floor space—no back breaking effort.

The battery powered TRANSPORTER is ready to operate at the trucker's command—forward or reverse—with complete brake and speed control. Just a movement of the handle—a push of the button (at operator's finger tip)—and away goes the load at safe walking speed.

NO STRAINING..TUGGING..PULLING..NOR PUSHING

POSITIVE MECHANICAL BRAKE — CONTROLS IN STEERING HANDLE
FORWARD AND REVERSE SPEEDS — FRONT WNEEL POWER DRIVE
SHOCKLESS HYDRAULIC LIFT WITH EASY FOOT CONTROL

MANUFACTURERS FOR OVER THIRTY FIVE YEARS *Electrical Propelled* INDUSTRIAL TRUCKS

AUTOMATIC TRANSPORTATION CO.

63 WEST 87th STREET — DIV. OF THE YALE & TOWNE MFG. CO. — CHICAGO 20, ILLINOIS

with Stainless Steel

THE lives of our fighting fliers, and the success of their sorties often depend on the unfailing operation of the superchargers that keep their engines roaring along steadily at full-rated power.

Some superchargers — driven by exhaust gases from the motors they serve—spin their fans more than 21,000 times a minute, heat up to temperatures as high as 1200° F That is why they are made of stainless steel, the metal whose use was directed for plane parts exposed to high temperatures and extreme corrosive conditions

Our metallurgists have developed U·S·S Stainless Steels that retain the strength needed for this high-pressure job at temperatures up ro 1650° They have worked out formulas, within the limits set by government directive, which have proved successful in handling the highly corrosive gases exhausted from "doped" fuels.

Tougher, stronger stainless steel depends, for its unique qualities, on accurate composition and skillful heat treatment. Precision control, specialized equipment and the experience of skilled workers insure the uniformly high quality of U·S·S Stainless Steel.

The services of our technical staff are at your disposal at all times They will be glad to consult with you regarding your present problems and future plans Drop us a line today Of course, you incur no obligation.

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SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
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UNITED STATES STEEL

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Gits Oil and Grease Seals represent over thirty years of lubrication research.

Specialized research, design and manufacture of industrial Oil and Grease Seals, and Lubricating Devices have provided the solution to many problems years ahead of the times Our war effort has hastened this research—crowding the achievements of many years into but a few —to meet the demands of ever closer tolerances and higher standards of efficiency of both mechanized units and industrial equipment These years of scientific research have developed the intangible values that insure dependable performance under all conditions, found in all Gits Lubricators. These years of specialization have indelibly specified the name Gits wherever lubrication is an essential. Let Gits solve your problems the scientific way.

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Sound the Alert!

MANAGEMENT
LABOR

—for the 5th War Loan drive during June and July. The need for the 5th War Loan is immediate, crucial. For impending events may make the 5th the supreme financial effort of the war.

The U. S. Treasury has set the overall goal at $16,000,000,000 — $6,000,000,000 from individuals alone. This is the biggest sum ever asked of the American people—*and it must be raised.*

That's why the U. S. Treasury asks Management and Labor to sit down together and organize—NOW!

For organization—good organization—has been responsible for the excellent showing of the payroll market. And its most important single superiority has been personal solicitation—desk to desk, bench to bench, machine to machine personal solicitation. 71% of all persons on payroll deductions were solicited for the 4th War Loan.

Now, to personal solicitation, add the sales incentive of a definitely established plant quota. Build your campaign around a quota plan. Set up departmental goals. Stress percentage of participation figures. Stimulate group enthusiasm.

In planning your quota campaign, work in close cooperation with the Chairman of your War Finance Committee. Everything is set to make the 5th War Loan drive a huge success—with your help!

(Note: You've read this message. If it doesn't apply to you please see that it reaches the one person who can put it in action!)

Here's the Quota Plan:

1. Plant quotas are to be established on the basis of an average $100 *cash* (not maturity value) purchase per employee.
2. Regular Payroll Savings deductions made during the drive accounting period will be credited toward the plant quota.
3. 90% of the employees are expected to contribute toward raising the cash quota by buying extra 5th War Loan Bonds. 1—Outright by cash. 2—By extra installment deductions. 3—By extra installment deductions plus cash.

Example: JOHN DOE Mfg. Co. — 1,000 Employees

1,000 employees x $100 Regular Payroll deductions during the eight weekly payroll Accounting Periods of June and July = $100,000 Cash Quota

30,000 / $70,000 (to be raised by sales of extra Bonds to at least 900 employees)

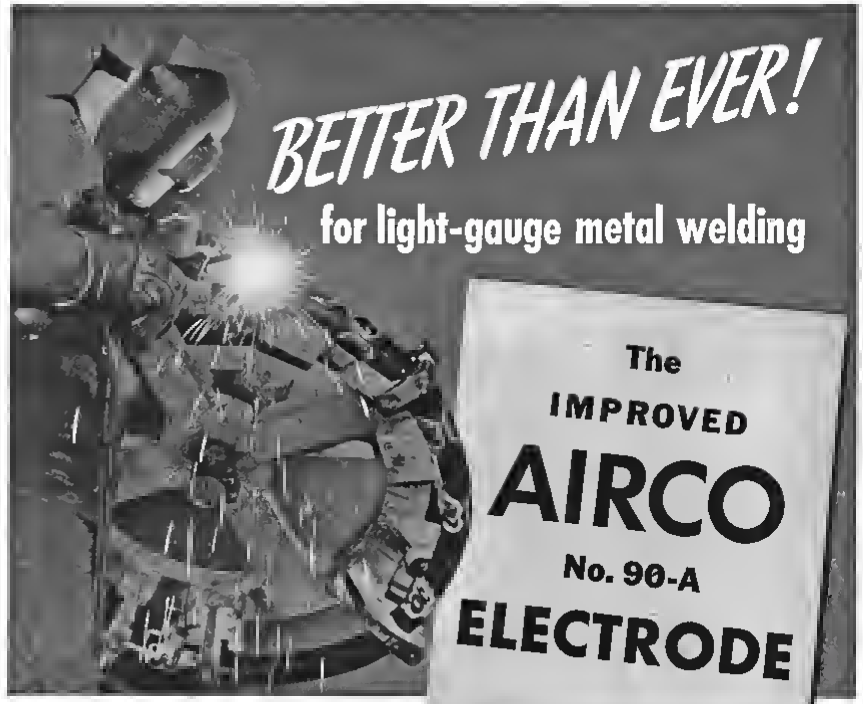
5TH WAR LOAN

ORGANIZE • SOLICIT • DELIVER

The Treasury Department acknowledges with appreciation the publication of this message by

AVIATION

★ ★ *This is an official U. S. Treasury advertisement—prepared under the auspices of Treasury Department and War Advertising Council.* ★ ★



Made in 1/16", 5/64", and 3/32" sizes

IT'S especially designed for AC or DC welding of light gauge chrome-moly and similar steels used in aircraft construction. Made to a completely new formula, the Airco No. 90-A Shielded Arc Electrode provides these four notable improvements:

1. Better appearance of deposit
2. Stronger arc action
3. Reduced arc interference
4. Ability to work at higher currents without deterioration of coating at stub end

And that's not all! This electrode is available in all three popular aircraft welding sizes—1/16", 5/64", and 3/32" diameters, 9", 12" and 12" lengths respectively. It is used with AC and is also satisfactory for DC operation, straight or reversed polarity.

Test specimens welded with Airco No. 90-A show tensile strengths of 80,000 to 90,000 psi. It meets the requirements of U. S. Army Air Corps Specification 10286B, and conforms to A.W.S. and A.S.T.M. Specifications for Classification E 6013.

For complete details on the Airco No. 90-A, call or write any Air Reduction office. Or mail the coupon for prices and data on Airco's complete line of AC and DC electrodes.

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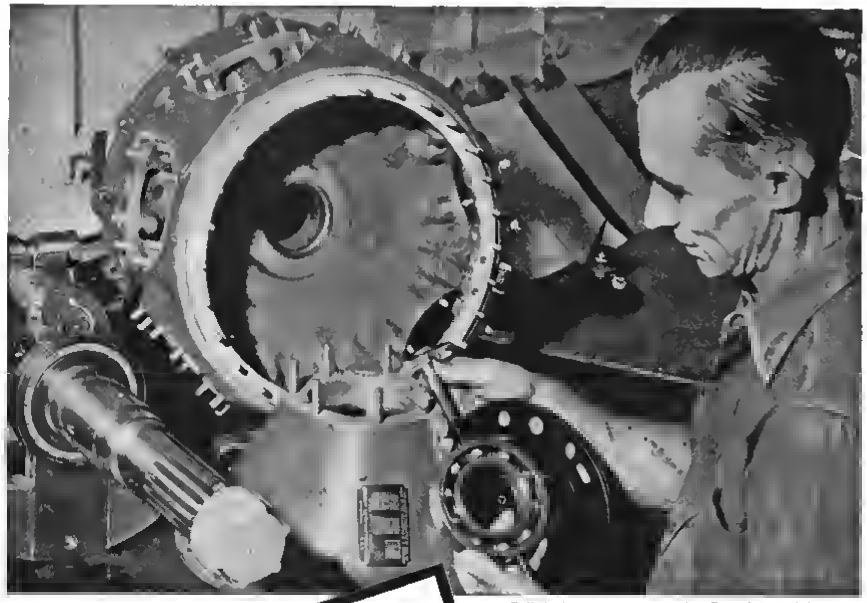
Please forward by return mail copies of—

☐ Airco Electrode Price List
☐ Electrode Consumption Calculator

Name
Company
Address
City State

AVIATION, June, 1944



• *Built by The Wright Aeronautical Corp. for a training plane used by Southwest Airways, Inc., this engine has SKF Bearings on propeller thrust and crankshaft locations—the 'heart' of an airplane.*

1,000,000 hours at Southwest

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So for safety, dependability and performance, airplane manufacturers, engine builders and ground crews almost without exception equip with SKF . . . the bearings that helped Sonthwest to establish a record of 1,000,000 military pilot training hours flown.

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5628

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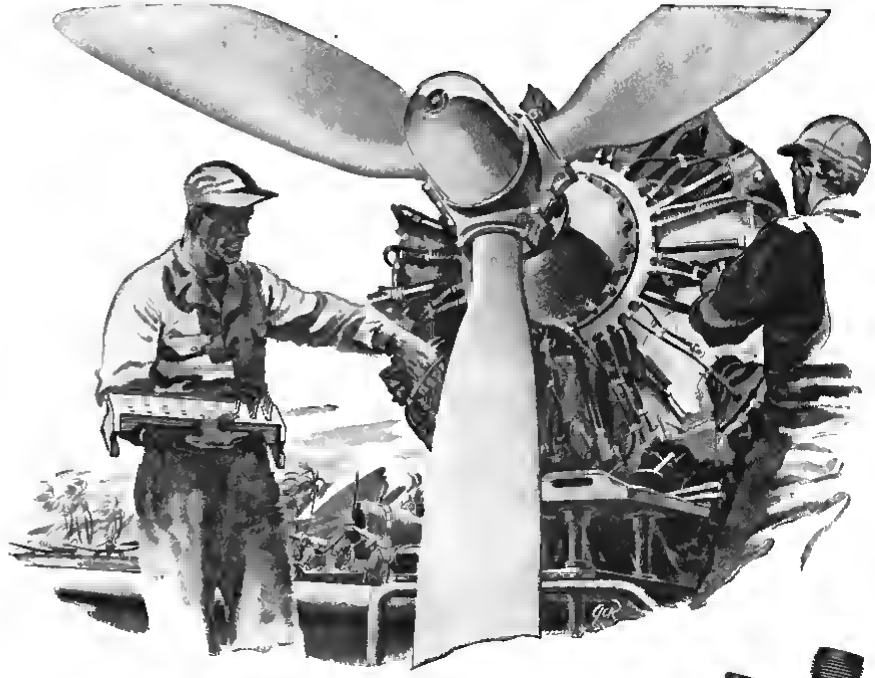
IN BOTH RADIO SHIELDED AND UNSHIELDED TYPES



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This is directly due to certain inherent characteristics that stem basically from the specially developed ceramic insulation and other exclusive and patented features around which all Champion Aircraft Spark Plugs are designed.

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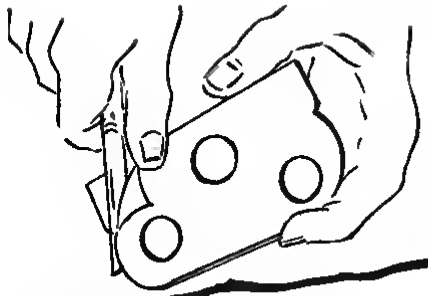
ONE MILLION HOURS CLOSER TO VICTORY

Post War Trade with SPAIN

Mr. Harry Walker, President of Harry Walker Sociedad Anonima will arrive in New York City sometime in June to meet old friends, to make new connections and to plan for future business.

Mr. Walker's company is the Irvin Air Chute representative in Spain and is well equipped for service and maintenance of parachutes as well as aviation instruments. A division of the business is devoted to automobile garage and service station equipment and is the oldest enterprise of its kind in the country.

For contact, awaiting his arrival, address Harry Walker Sociedad Anonima, c/o McGraw-Hill, 330 West 42nd Street, New York-18, N. Y.



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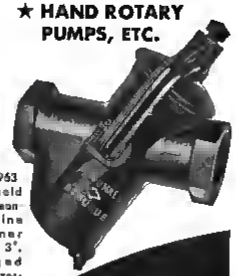

Plate 953
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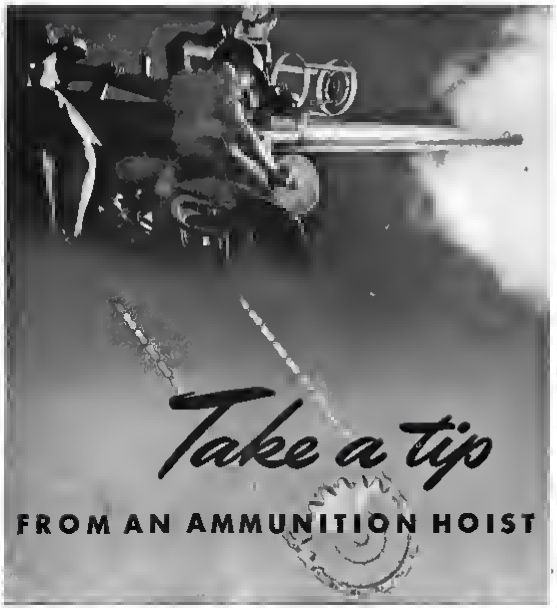

Take a tip

FROM AN AMMUNITION HOIST

In designing and manufacturing ammunition hoists for destroyers, DE's, aircraft carriers, troop transports, merchant vessels and many others, we were confronted by two major problems

One—*how to get shells and powder from magazine to gun turret fast?*
Two—*how to construct the hoist so that shock and vibration would not injure the operating mechanism?*

Aircraft manufacturers, military airfield and commercial airport operators must solve parallel problems. Problems involving the safe, sure, efficient movement of men and material—and heavy loads

Roto Drive may offer the solution

Roto Drive is a simple principle of operation based on the controlled movement of endless chain. Because it is so simple it is adaptable

It is not a "cure all". There may be some "man" handling and materials handling problems Roto Drive can't solve.

But Roto Drive has found varied application in many fields where the dependable movement of men and material is important. On carrier airplane elevators, ammunition hoists, galley Roto Waiters, between deck elevators, freight and passenger elevators and on many kinds of materials handling equipment

Believe us We hope you don't. Indeed, we hope you have a particular problem—present or postwar—involving the movement of men and material. We hope you will want to find out for yourself how Roto Drive can be used to solve that problem

A Sedgwick engineer will be happy to show you how Roto Drive will do the job better and faster—*at reduced cost.*

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AT *The Cradle of Aviation*

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How it feels to power dive 15,000 feet in a Flying Fortress

OFFICIAL STORY *from the book, "Target, Germany"**

Fuselage spars and chords made of SHELBY Seamless Aircraft Tubing help supply the tremendous strength needed in Flying Fortresses to withstand battle punishment.

"FREAK accidents occur on almost every mission. A Fortress named *Short Stride* was nearly lost when the life raft hatch in its fuselage flew open. The raft popped out and caught on the tail surfaces, jamming them. The Fort nosed up 300 feet, then went into a 15,000 foot power dive. Crew members were pinned against the ceiling. The interior of the ship became a shambles of wrecked instruments, broken glass, and scattered ammunition The co-pilot saw the navigator appear twice in the blister well of the bombardier's compartment, then just as suddenly disappear. It was like a crazy movie; first you saw him, then you didn't.

"At 10,000 feet the pilot and co-pilot managed to pull the Fortress out of the dive. The strain was too much for the bomb bay; bomb shackles tore loose, and bombs and bomb-bay doors fell into the sea.** Four members of the crew bailed out. The rest decided to stay with the ship and risk a crash landing. They made it with the life raft still lodged in the stabilizer."

***But the wings stayed on.*

• •

When you hear stories like this you have nothing but admiration for the men who fly these magnificent planes—and for those who design and build them Anything we can say about the strength of SHELBY Seamless Aircraft Tubing would be an anti-climax to the story But as an organization we are glad to have been able to supply the seamless steel fuselage spars and chords and the seamless tubing for engine mounts, landing gear and other applications that in actual service took a beating far beyond the dreams of the builders.

**Published for the Army Air Forces Aid Society by Simon and Schuster, Inc.*

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If you have a new idea for a product or a piece of equipment, whether a working model or just on paper, write us about it. Our engineers are experienced in developing practical plans of production.

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AIRCRAFT EQUIPMENT DIVISION

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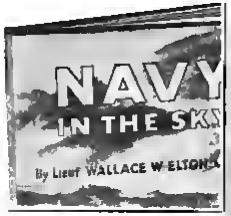
The impressive story of our Navy planes and flyers *in this brilliant collection*

of Navy photographs



Here is a striking collection of official Navy and Marine Corps photographs carefully selected and arranged to form a comprehensive outline of naval aviation. Originally designed for use in naval indoctrination courses, it gives you in pictorial form the story of our Navy planes and blimps and the men who are operating them. A descriptive commentary explaining the various types of planes, their appearance qualifications, and duties accompanies the photographs.

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104 pages, 9¾ x 7¼. 128 photographs. $2.00

This is a graphic presentation of the Naval Air Force—its men—its machines—and its objectives. Beginning with a few notes on the history of naval aviation, the book includes an explanatory diagram and a list of the typical parts of an airplane. It explains carrier flight deck operations and takeoff and landing procedures for landplanes, and shows the seaplane, its launching, landing, and maintenance. Other topics covered are flying boats, blimps, Marine Corps planes, etc., etc. This is a book that not only provides you with a complete introduction to naval aviation, but also gives you the best of the U. S. Navy photographers' art. It is a powerful commentary on the men and machines of our air-born Navy.

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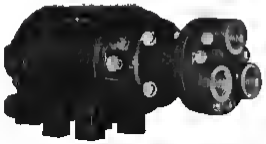

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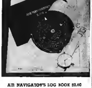

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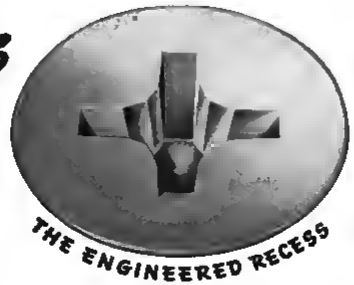

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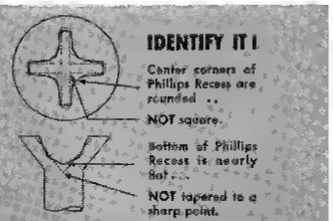

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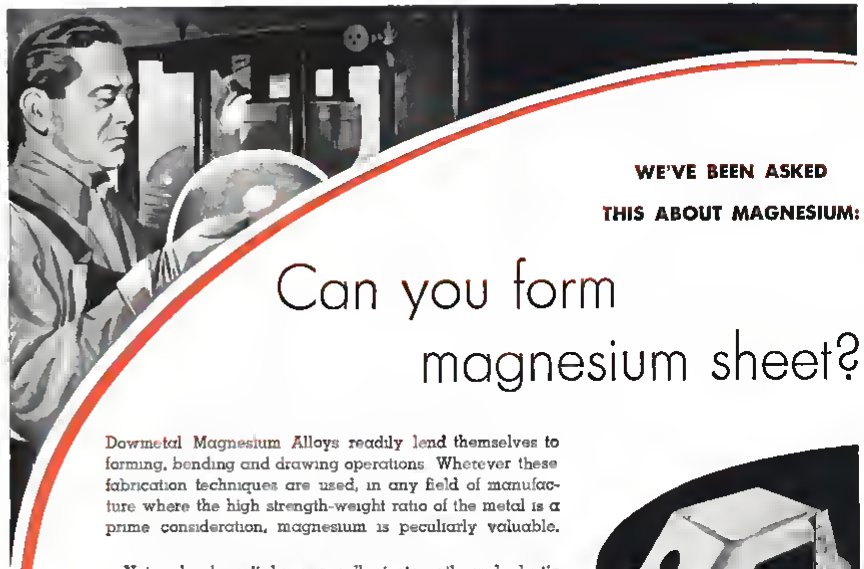
American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The British Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell-Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.



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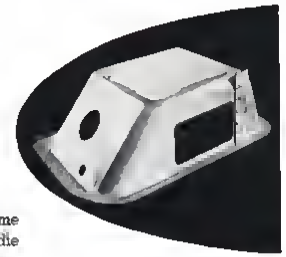

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